

# Aviation Week & Space Technology

July 16, 1962

Sensors Planned  
For Apollo  
Rendezvous

A McGraw-Hill Publication

Vertol 107-2 in USAF Markings





*"Once he had to interrupt his radio communication to fish for a loose washer that was floating around his cabin"\**

\*See *Aerospace Journal* L-100/82

It's the little design details that may result in the difference between a successful mission or...irritation, frustration or worse, disaster.

Eliminate loose washers. The Kaylock HW14 series "Caprice Washer" nuts were designed to eliminate the possibility of loose washers being dropped and forgotten... with the resultant possibility of malfunction of mechanical equipment or sheet events.

Write for the HW14 brochure or contact your Kaylock representative.



**Kaylock**

just in all-weather landing gear nuts



Available in sizes No. 208, 210, 212, 214. In carbon steel or stainless steel, non-magnetic. A-36.

KAYLOCK MFG. CO., INC. AVIATION DIVISION • 100 30th Street, Santa Ana, Calif. 92703



**Nothing handles "hot" landings like this new air-cooled brake...and we speak from experience**



This new forced-air-cooled braking system, developed by Goodyear and being evaluated by Douglas Aircraft Corporation and the U.S. Navy, promises to reduce still-air cooling time by 90%.

Performance is more consistent than ordinary systems because component temperatures are kept significantly lower.

This also effectively increases service life.

Brakes stay cooler in long take-offs, prevent over heating of wheel assemblies from frequent take-offs and landings on short hops. And between air is the cooling agent, there's

no metal medium to heat, store or handle.

The simplicity of this system also results in a high level of reliability compared to more complex, heavier braking systems.

This air-cooled brake is typical of many new developments by Goodyear Aviation Products and the largest, most experienced technical engineering staff in the business.

If you'd like to know more about Goodyear's new air-cooled brakes or any other new developments, just write to Goodyear, Aviation Products, Dept. B-2118, Akron 16, Ohio.

**GOOD**  
**YEAR**  
AVIATION PRODUCTS





**Say, "Ahhhh!"**

**Be "Amoco-aware" ... Aircraft radiography demands Amoco Superey H-D<sup>®</sup>** — the first, ultra-fine-grain American X-ray film for pinpointing the smallest manufacturing defects or stress fatigue. Besides its critical definition, this film's high contrast records more minute details—which would only show up marginally on conventional films.

*For radiography—it's Amoco best by definition.*

Amoco—America's first manufacturer of photographic materials...since 1842

**AnSCO**

X-RAY FILM  
CHEMICALS  
SERVICE

## AEROSPACE CALENDAR

- (Continued from page 5)
- Aug. 21-Sept. 5—Society World Publishing Championship Orange Meet. Sponsors: National Aerospace Assn., Ranches Club of America.
- Aug. 21-26—Aerospace Energy Conference Cen. Univ. of California at Los Angeles, Los Angeles, Calif.
- Aug. 23-26—Symposium on Infrared, Visible and Space Technology. U.S. Air Force Academy, Colorado Springs, Colo. 80933, USA.
- Aug. 24-26—Cryogenic Engineering Center Univ. of California at Los Angeles, Los Angeles, Calif.
- Aug. 24-17—Instrumentation Conference on Precision Electromagnetic Measurements. Boulder Laboratory, National Bureau of Standards, Boulder, Colo.
- Aug. 15-17—Aircraft Propulsion Conference, Mountain, Calif. Joint Meeting Institute of the Aerospace Sciences, American Rocket Society, American Nuclear Society.
- Aug. 25-27—The 1st International Electronic Circuit Packaging Symposium, University of Colorado, Boulder, Colo.
- Aug. 30-31—Solvay Electrode, Lafayette Flying Corps and Association of the French Foreign Legion, Et Braus Am. Hotel, Paris, France.
- Aug. 19-22—Annual Meeting and Conference, American Optical Council, Princess Kaiulani Hotel, Honolulu, Hawaii.
- Aug. 26—Tokaimu Symposium, Precision Instrument Manufacturers Assn., 5501 E. Higgins Road, Upland, Calif.
- Aug. 21-24—International Ultrasonic Meet. and Exposition, Institute of Radio Engineers, Los Angeles, Calif.
- Aug. 21-25—International Symposium on the Infrared Spectroscop., Shonan City Inn Hotel, Kawasaki, Kanagawa, Japan.
- Aug. 21-25—International Symposium on Ultrasonics, University of Illinois, Urbana, Ill.
- Aug. 25-Sept. 17—19th Session International Civil Aviation Organization, Ancona, Italy.
- Aug. 27-28—Quality Improvement Meeting Ass. of Land Transport Admins., Westin Hotel, Atlanta, Ga.
- Aug. 31-Sept. 4—Conference on Thin Film, Colorado Metal Glass and Sprays, Colorado State Solid State Electronics Laboratory, University of Denver, Denver, Colo.
- Aug. 27-28—Advanced Electronic Materials Show, Hotel Roosevelt, Los Angeles, Calif.
- Aug. 27-28—1st Annual International Congress on Advanced Materials Processing, Institute for Processing Research, Marchant, Ill.
- Aug. 28-30—Fourth Conference on Mass Transfer of Electronic Equipment. Electro-Science Institute, San Jose, in conjunction with Department of Defense, University of California, San Diego, Calif.
- Sept. 1-2—National Advanced Technology Meeting Conference, Institute of the Engineers, Seattle, Wash.

(Continued on page 9)

## HEAT EXCHANGERS IN A HURRY



(Dr. A new slant on  $q = \rho c (L-L_0) \Delta T$ )

Heat exchanger design problems are reported to triple young men day and older men halve. It thus gives us joy to report that Budd heat transfer engineers are today retaining whatever residual advantages they started with. Yes, we profit thereby from our extensive experience in prototypes and production services for plate-fin heat exchangers. We produce these compact, lightweight and highly efficient components by both dip-brazing and epoxy bonding...with aluminum, stainless steel, copper and other materials...in myriad configurations for remote cooling, intermediate or modern air conditioning systems and other heat, air, or space applications.

What's new about that? Just that

"We design the best heat exchanger for a given application, a combination of components, intermediate thermal variables, heat transfer rate, thermal insulation, transfer area, heat- and cold-side temperatures, etc., etc., are usually planned around until the required heat transfer rate is attained." (During this labor, the designer must also find a way to translate such vital external requirements as, weight, strength, reliability and cost.)

We now announce, as modestly as possible, that this breakthrough, this breakthrough in design techniques that enable plate-fin component heat exchangers to be designed and produced faster than ever before!

This is not the result of an overnight invention. Our Environmental Control Systems Department has long been busy with a fresh and data-seeking investigation of am-

bitized approaches to heat exchange design. Their study was partially abetted by the experience, the knowledge of practical operating conditions, and the voluminous test data we've accumulated in over 20 years of designing and producing conventional heat-exchanging systems, as well as recuperative exchanges and other types of environmental control systems.

Our new design method enables us to optimize exchanger relationships and values with surprising speed. In several recent cases, we've designed, overhauled new exchangers in a few hours!

How do we do this? The details we guard, but we can say that design reliability as well as speed is assured by a pre-optimized, pre-arranged, pre-tested, a moment of finalization, we target that new method "Feedforward-Correlated Design." (It may sound like other entries in literature, as contained in our heat exchanger believe, which will naturally sound no rhyme. If you don't already belong to the Budd Electronics Crew and Marching Society, be sure to ask for your membership credentials too!

There is, of course, an innumerable number of other ways to reduce substantial design time and design and deliver your next exchanger. Why not? Environmental Control Systems, Budd Electronics, 63-2525 Quince St., Long Beach City 1, N.Y.

regarding license claims, there also is another unique advantage: communication with Advanced Studies, Research & Development, which can be used to develop new, unique, and effective heat-exchanging techniques.

DATA PROCESSING & DATA SYSTEMS  
RF SYSTEMS & COMMUNICATIONS  
ENVIRONMENTAL CONTROL SYSTEMS  
SYNTHETIC ORGANIC POLYMERS-ENG.  
FIELD ENGINEERING

**Budd** ELECTRONICS  
A DIVISION OF THE BUDS COMPANY INC.



The leading and trailing edge slats for the Lockheed F-104G, actuated by Eemco systems, were originally used for landing and takeoff only. When they were used for maneuvering as well, aircraft increased sharp. To protect the structure from overinertias, Eemco designed a mechanical disengagement that automatically disengages the motor from the servo actuator when preset loads, protects over-loading of the motor clutch. An additional feature of one motor of a leading or trailing edge set fails, the other automatically takes over and drives both actuators. For the F-104G, Eemco delivers optimum muscle, instantly, precisely as required.

At Eemco, more than 4,000 different custom actuators, motors, and servo generators have been manufactured in the last 20 years. If you would like custom muscles for your aircraft, missile or space system, please write to Dept. CEC.



E-102 Actuating System - Leading Edge Unit

Type 4, 1000 lb. force, 1000 lb. load, 1000 in. stroke, 1000 in. resolution.

Resonance: 1000 Hz.

Stiffness: 1000 lb./in.

Max. Acceleration: 10 g's.

Response: 1000 in./sec.

Resonance: 1000 Hz.

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*Mindpower and Manpower...  
shaping the future in*  
**COMMUNICATIONS  
and ELECTRONIC SYSTEMS**

**ENGINEERS:** Today the men at Motorola are developing mancalous solutions to the complex problems of America's most advanced communications and electronic systems.

Creative manpower is being applied to such vital areas as the Navy's sonar and sonographic instrumentation programs...the Army's VHF single side band radio control system...the Air Force's UHF ground-air communications system...and NASA's close-in and deep space tracking programs. Advanced studies are also being made in random access digital communications, digital-to-voice translation, high speed teleprinting, phased arrays and solid state circuitry. To participate in this challenging work, write today describing in detail your experience in the following areas:

**Systems Design:** Analysis and synthesis of complete systems for operation in hydrospace, surface and aerospace environments. Plasma, electron engineering and spaceliner research.

**Equipment Design:** High performance solid state receivers, transmitters, frequency synthesizers and data handling equipment for radio and communications systems; sonar/sonic probe instrumentation systems and display complexes.

**Familiarity with State-of-the-Art:** Statistical communications theory, advanced signal processing techniques, ultrahighabit through application of low-level technology, advanced structural and thermal designs for severe environments.

We are particularly interested in the progression on what this experience was obtained, and the extent of your technical responsibility. Address inquiries to our Manager of Engineering at the location of your choice for immediate and confidential attention.

An equal opportunity employer  **MOTOROLA**

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MILWAUKEE, Wisconsin 53201



**UNITED JETS...  
FAR AHEAD IN BUSINESS TRAVEL**

United jets arrive and depart well over 400 times a day from the top five markets alone... New York, Chicago, Los Angeles, San Francisco and Washington-Baltimore. In these key markets, United has nearly twice as many jet departures and arrivals as the run-up airlines.

But the world's largest jet fleet... and frequent jet schedules... are only part of the United story. United has the finest service to the business centers of the U. S. For example...

**United serves the aerospace industry**—United serves 18 of the 22 major centers of the aerospace industry... more than any other airline.

United serves more U. S. cities by jet—when you are traveling on government business the best way to get speed and convenience is to make one call... to United.

United has new transcontinental service—on your next coast-to-coast flight make your reservations on one of the frequent nonstop flights provided by United's DC-8 Mark IV Jet Matinees®.

Whenever you or your products travel by air—specify United Air Lines. Your local United sales office will be glad to serve you.

Mark IV is United Air Lines' designation of the advanced DC-8 model equipped with most powerful JT-4 and turbine engines.



**UNITED**

WORLD'S LARGEST JET FLEET / THE EXTRA CARE AIRLINE



## E-P'S NEW FLIGHT CONTROL IS IDEAL FOR LONG RANGE CARGO AND TRANSPORT AIRCRAFT...

The new Eclipse Pioneer Series 80 Autometric Flight Control System combines versatility, reliability and light weight in a package that is equally suitable for short-haul and executive aircraft as well as for commercial airliners and high-performance jet transports. Price and weight are commensurate with the economics of the smaller aircraft. Finally, an advanced flight control system that features the latest state-of-the-art electronic circuitry and more advanced components designed to bring pilots and operators the highest degree of convenience, acceptance and reliability.

The new FB 80 Autopilot is the heart of this lightweight flight control system. It's reliable and simple to monitor. The Series 80 package also includes the CE 80 Computer and the FD 80 Flight Director. 30 different configurations are available for everything from a simple single channel control to a completely redundant system with dual flight director and computer. All subsystems are completely inter-



## SHORT-HAUL AND EXECUTIVE AIRCRAFT...AND EVERYTHING IN BETWEEN.

patible and are available individually as well. It's the ideal system for executive jets and short-haul aircraft—as well as for high-performance transports and practically anything else that flies. Once in pilot. The PB 80 Autopilot has been ordered for the Lockheed C 141 jet transports. The same system will be installed on the Douglas Proline PD 1000 executive transports.

The Series 80 Flight Control package is a typical example of E-P's capability in engineering equipment to meet the up-to-the-minute requirements of late model aircraft. This capability is backed up by the more than 500,000 cubic feet logged by aircraft carrying Eplex® Autometric Flight Control equipment, and by the fact that we have supplied over 80 per cent of the industry's requirements for long and medium range airline aircraft.

Take advantage of our long experience in the manufacture of flight control equipment. You can get in touch with us in Teterboro, N.J.

**Eclipse-Pioneer Division**



WHERE IDEAS  
UNLOCK  
THE FUTURE



## UNITED JETS... FAR AHEAD IN AIR FREIGHT LIFT

United jets arrive and depart well over 400 times a day from the top five markets alone... New York, Chicago, Los Angeles, San Francisco and Washington-Baltimore. In these key cities, United has nearly twice as many jet departures and arrivals as the runner-up airline.

But capacity to carry freight... and more frequent jet schedules... are only part of the United story.

In addition, United has air freight services designed to help solve your most complex shipping problems:

**United Air Freight experts at your service**—United Air Freight Customer Service Centers across

our system are staffed with experts... 24 hours a day... to answer your questions... to monitor your shipments.

**United reserves space for your shipments**—United's Reserved Air Freight sets aside positive space for your shipments, coming or going, in both United jets and Cargojets.

**United offers Passenger Reserved Air Freight**—This economical service lets you take sample cases or other business materials on the same plane with you... at low air freight rates.

Wherever you or your products travel by air—specify United Air Lines. Your local United sales office will be glad to serve you.

# UNITED

WORLD'S LARGEST JET FLEET / THE EXTRA CARE AIRLINE

HOW TO  
KEEP DUST  
FROM  
BITING  
THE DUST



**1000 times more conductive  
"SCOTCH" Heavy Duty Tapes  
drain off static-caused  
dust problems!**

Arboreous dust can be a long-term problem when it separates resistive tape from signal, or from microscopically recorded data. That disrupts circuits as today's higher tape speeds and tensions generate more and more dust-disrupting static electricity. That's one reason why high-speed recorders need "SCOTCH" BRAND Heavy Duty Instrumentation Tapes... they provide 1000 times greater conductivity than ordinary tapes, draw off static charges before they cause trouble!

Electrical resistance of the heavy-duty static coating is

only 300 megohms per square or less. Since it readily dissipates to keep tape clean, prevent each other static problems as tape drag and tension, as well as static induced by arcing.

"Scotch" Heavy Duty Tapes outwear conventional tapes at least 15 times. Special binder and high-purity oxide formulation delivers broad-band load-life, withstands temperatures from -40°F to as high as 320°F.<sup>1</sup> Silicone lubrication prevents regular static and tape against metal

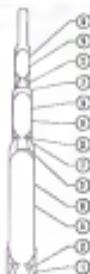
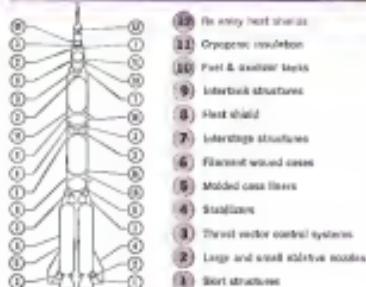
16 different "Scotch" Heavy Duty Instrumentation Tapes offer a variety of backing and coating thicknesses, provide conductivities for all high-speed applications, even for extreme high frequencies, exceed short wavelength requirements. For details, call the 3M representative, or write Magnetic Products Division, Dept. MCA-71, 3M Company, St. Paul 69, Minn.



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**Magnetic Products Division** **3M** certified

**count down  
on our  
capability  
in  
component  
fabrication**



For specific information on  
counting the cost of our  
component manufacturing capability  
please address Marketing Manager,  
Desertland 121, Rohr  
Corporation, Chula Vista, Calif.

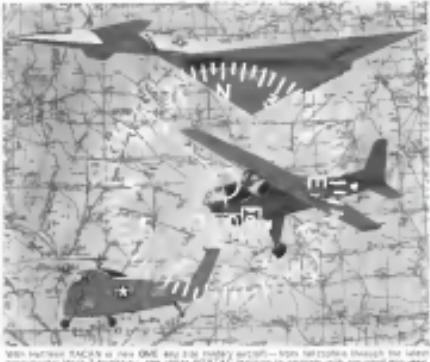


**ROHR  
CORPORATION**

3M Print and Instrumentation Units  
West Palm Beach, Florida  
Assembly Plants, Atlanta, Georgia,  
Wichita, Kansas

Offices: Los Angeles, Calif. and  
Chicago, Ill.

**NOW—  
VORTAC  
NAVIGATION  
FOR ALL  
MILITARY  
AIRCRAFT**



Hoffman TACAN is now OEM. Any size military aircraft—tugs, fast jets, transports, the latest experimental Mach 3 interceptors—can utilize VORTAC facilities to navigate with pinpoint accuracy.

Hoffman TACAN and DME offer small aircraft—as well as the largest—a proven, practical way to gain full benefit from nearly 1100 VORTAC stations now operating and under construction.

- Combining both distance and bearing information, Hoffman TACAN is the only such gear volume produced to AGREE specifications (Advisory Group

Hoffman ARN-6 TACAN is the latest version. It is the first TACAN ever to use solid-state logic, solid-state power and feature rugged, compact solid-state design.



on Reliability of Electronic Equipment). Reliability has been increased more than 800% by raising MTBF from 17½ to over 150 hours—with a service life in excess of 2000 hours. Your inquiry is invited.

Product project Hoffman TACAN and DME is now in final flight test, using solid-state power and feature rugged, compact solid-state design.



■ Latest ARN-65 TACAN has ready application to a variety of aircraft, including TFX, F-104, N-156F, B-58, T38 and RS-70.

- New Hoffman DME supplements existing VOR in aircraft to provide full VORTAC data. In a long ½ ATR package, it weighs 28 lbs., operates on 28 VDC or 115 VAC power. Plug-in auxiliary azimuth adapter can be furnished to provide bearing data.
- Active producer of over 20,000 airborne TACAN systems and a complete line of TACAN test

**Hoffman**  
ELECTRONICS CORPORATION  
**Military Products Division**  
1500 South Belvoir Avenue, Los Angeles 17, Calif.

*Of interest to engineers and scientists*



## ANTARCTIC RIOMETER PROGRAM

...one of more than 500 R&D programs under way at Douglas

This Douglas program is being conducted in cooperation with the National Science Foundation with these objectives:

To investigate the apparent existence of a world-wide semi-annual variation in the occurrence of polar cap absorption events; to determine the frequency and time-intensity of solar cosmic-ray events; to correlate North and South Pole monitor measurements and study differences in the polar ionosphere; to study the effects of radiation on ionospheric parameters.

The program will continue through the next solar sunspot maximum in 1989. Among other aspects, it will be useful in setting up criteria for the protection of astronauts from radiation.

**Of career interest to engineers and scientists**  
Douglas has entered into a period of greatly expanded activity in research programs like the one above and huge development projects like

SkyShuttle, Saturn IV, Rebound, and others. Outstanding positions are now open in practically all scientific and engineering fields related to missile systems and space exploration.

Scholarships and financial assistance are available to continue your studies in such nearby universities as U.C.L.A., Southern California and Cal Tech.

Send us your resume or fill out and mail the coupon. Within 10 days from the receipt of your letter, we will send you specific information on opportunities in your field at Douglas.

Mr. F. V. Edmunds  
Missiles and Space Systems Division  
Douglas Aircraft Company  
3600 Ocean Park Boulevard  
Santa Monica, California

Please send me full information on professional opportunities in my field at Douglas.

Name \_\_\_\_\_  
Institution \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**DOUGLAS**  
Missiles and Space Systems Division  
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## INSTANT INTELLIGENCE FOR INSTANT DECISIONS

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## EDITORIAL

### A Bold Decision

National Aeronautics and Space Administration has made a bold decision to push for lunar orbital rendezvous as its primary method of landing men on the moon and returning them safely to earth within this decade. The decision was made unanimous by NASA's Manned Space Flight management council headed by Dr. Bernard Lovell (AW July 2, p. 37, July 9, p. 25), with the firm conviction that this technique offers the best possibility for exceeding the lunar mission substantially sooner than any of the other admittedly feasible techniques, such as earth orbital rendezvous using a liquid oxygen tank in the direct ascent. Yet the NASA decision retains a good deal of flexibility by developing additional capability for direct ascent with hardware already under development (see p. 32), and bolstering the lunar rendezvous option with a special logistics vehicle to support the astronauts on the lunar surface. And it has finally found a firm place in the space launch vehicle spectrum for the much-lauded moon boosters, now rated as having two to three times the payload capacity of Saturn C-5. "NASA development will be deferred from an early lunar landing horizon to a support role for later and larger scale lunar and interplanetary operations."

The NASA lunar rendezvous decision offers several significant clues as to how the U.S. space program is moving now, in contrast to its earlier years. It provides some tangible evidence of the malleable spirit we found earlier in the working tools of NASA and its aerospace industry support during the preparation of the special July 2 issue of *Aerospace, Water & Space Technology*, "NASA—Spacecraft to Space."

### NASA's Progress

First, the basic concept of lunar orbital rendezvous is an idea that was little more than a gleam in the eye of Langley Research Center's John H. Glenn when President Kennedy established the lunar landing as a national goal nearly 14 months ago. Second, its working development into a full-blown, well-rehearsed program capability for the lunar mission is a significant indication of the inquisitive, analytical technical health that characterizes the aura of NASA's scientific soul. Third, the decision-making process that was carried out in six months of the roughest type of technical arguments and rebuttal, and reached in the unanimous verdict to go, prior to a lunar orbital rendezvous, is a good example of the speed and courage with which the NASA managers are moving to reach their presidentially assigned goal.

A manned voyage to the moon is certainly a risky enterprise and an national space program is going to land an astronaut there first without taking some care fully calculated gambles. The lunar orbital rendezvous decision is this type of bold action, based on a reasonably sound technology but still spaced with considerable

risk, that has been a hallmark of U.S. success in the past and should continue to spur its future development. It is a complete rejection of the ultra-conservative technical philosophy that inhibited the growth of new technology so substantially during the late fifties.

The lunar orbital rendezvous decision appears four basically new technical requirements on the aerospace industry. They are:

- Development of the two-man lunar long fat landing on the moon from the Apollo mother ship in lunar orbit and making a rendezvous with this ship after lunar take-off for the return trip to earth.
- Development of a logistics support vehicle to deposit food, oxygen and other supplies on the lunar surface for use by the astronauts during a lunar stay.
- Development of increased power from the currently planned Saturn C-5 stages and development of a much lighter reusable Apollo command and service module for a possible direct ascent to the moon in the event lunar orbital rendezvous fails.
- Development of a large upper-Nova type space booster with the ability to boost several hundred thousand pounds of payload to escape velocity.

### Tremendous Task

In addition, the aerospace industry, along with the NASA program managers, have a tremendous task to develop in the Apollo and Saturn hardware already contracted for a technological excellence and operational reliability beyond anything not achieved.

It was also a refreshing change in veterans of manned space flight peers conference to find NASA Administrator James E. Webb with his three top managers in their seats—Dr. Robert C. Seamans, Jr., Dr. Holmes and Dr. Joseph Shea—soundly absent to their audience without the benefit of a public relations-type interlocutor whose behavioral accuracy and candor failed to match that of the principals. These three relatively young NASA managers did a particularly lucid job of explaining the details of lunar orbital rendezvous, the reasoning that evolved into this basic decision and the philosophy with which they intend to execute the mission from landing flight.

The lunar orbital rendezvous decision is certainly a bold one. The ultimate proof of its wisdom, of course, must wait until the latter half of this decade when the race to the moon between the U.S. and the USSR will enter the final stretch. A lunar flight will probably be forthcoming in 1965 when the basic elements of the lunar orbital rendezvous mission will get a thorough operational testing in earth orbital flight.

But we, like *Aviation Week*, NASA's lunar orbital rendezvous decision opens a basically new possibility for achieving success with the lunar landing mission and increasing the odds substantially on the U.S. winning this race.

—Robert Hotta



## BOTH BIRDS IN THE READY INVENTORY

... and for getting key people and critical parts to and from widely dispersed missile sites, nothing can beat the United States Air Force's H-43D HUSKIE. It's a twelve place tilt-tilt or a two-ton cargo carrier with rear loading thru clear shell doors.

Performance? The rugged, reliable United States Air Force HUSKIE set five new world records in the past year for altitude, payload, and time to climb.

Putting the inventory helicopter to work in the MISSILE SITE SUPPORT mission makes dollars and sense in program time and costs.

## WHO'S WHERE

### In the Front Office

**Andrew F. Hardwick**, president, Advanced Division of Learjet Corp., Inc., St. Louis, Mo.; **Col. Alan R. D. Cather**, executive vice president, Space Equipment Division of Lear Siegler, Inc., Cleveland, Ohio.

**Charles A. Gaudet**, director, ion power nuclear program and N. Richard Miller, division vice president/business planning, Defense Electronics Services, Radio Corporation of America, N. J.

**Albert D. Anderson**, vice president, Cook Electronics Co. and manager of Cook Technical Center, Morris, Ill.

**Stanley L. Gorlow**, vice president, Phoenix Aircraft Corp., Philadelphia, Pa.

**John B. Schaeffer**, president, aerospace division, General Dynamics Corp., Radio Intercept Division, Herkville, N.Y.

**Frederick J. Danner**, Corp. vice president, Vice President John C. Chan is executive head of the company's Washington, D.C., office, succeeded Ted Stassett, resigned. John F. Schaeffer remained Mr. Chan's direct supervisor. **Frederick Danner**, director of development and Control Division, Grand Rapids, Mich.

**Charles H. Zimmerman**, director of analytical research, Office of Advanced Research and Technology, National Aeronautics and Space Administration, Washington, D.C.

### Honors and Elections

**S. K. Hoffman**, president of Rockwood Division of North American Aviation, has received the American Society of Mechanical Engineers' Spirit of St. Louis Medal for his "outstanding contribution to aviation aerospace and rocket industries through the development of the first major hydrogen rocket."

**Geoffrey E. Beck** and **Merwyn Marquie**, Marcus Welles Telegraph Co. senior engineers, have been honored the Johnson Memorial Medals by the Guild of Air Pilots and Air Navigation for work on development of the first transatlantic flight.

**Karl J. Boman**, former director of Guided Missiles and Dynamics/Advionics has received the Society Interplanetary Society's Astronautics Medal for his "individual contribution to the cause of aeronautics, particularly in the engineering sciences."

### Changes

**Capt. Joseph G. Christian**, (USN, on contract), has joined the Space Environment, Inc., Ft. Lauderdale, Fla.

**John Craig, Jr.**, contract sales manager, Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., succeeded James R. Lee (AW, Aug. 2, '71). Also **Hugh A. Connelly**, marketing manager for government products, has joined the company. He has experience in aircraft and missile research and development, North American Aviation's Colorado (Kirtland) Division.

**Miguel van Bommel**, director-engineering and research, Chrysler Corp.'s Mobile Division, Detroit, Mich., and **D. G. White**, director-administrative and computers.

## INDUSTRY OBSERVER

►Propulsion scheme being considered by National Aeronautics and Space Administration for the Apollo capsule's lunar "bog," presented for use as a personnel shield between the Apollo in moon-orbit and the lunar surface (AW, July 9, p. 25), includes non-explosive pressurized liquids, flooding capability, and allowing sheet metal.

►Avco Corp.'s Research and Advanced Development Division has won USAF Ballistic Systems Division's competition for a low-observability strategic vehicles program, called LORV (AW Apr. 16, p. 34). The program is aimed at developing military vehicles with a minimum of radar cross section as part of a stepped-up overall ballistic missile penetration and effort.

►An Air Force plan a design study of a 200-ft-dia lunar environment chamber to subject a lunar landing capsule and equipment to realistic simulation of all reproducible physical conditions expected to be encountered on the moon. USAF Missile Development Center, Edwards AFB, Calif., plan to award a contract to an educational institution or a non-profit organization.

►National Security Industrial Assn. has endorsed Defense Department management concept that weapon systems development should be provided by a feasibility study sufficiently broad in scope to demonstrate technical, cost and schedule feasibility. This, it runs, should be applied to Total Systems Feasibility Determination as part of the "Program Package" concept, NSIA says, to assess its military value, in relation to competing systems, its financial and the government's ability to field it through its defense

►De Havilland Aircraft has forced no need for the outboard ailerons on the Trident aircraft because production costs will not sacrifice this feature. Test flying has been accomplished with both outboard ailerons locked in place. Flight testing is now in production, and the third Trident will roll out shortly.

►Proposals for a census and data storage installation, designated Visual Information Subsystem (VIS), to be carried on the non-orbiting Surveyor spacecraft, have been requested by Jet Propulsion Laboratory. Submission date is Aug. 8.

►U.S. Army Control and Guidance Agency is reviewing industry proposals for the design and evaluation of inspection systems applicable to the banning of weapons of mass destruction in space.

►Proposals for a study of qualification test requirements for prototype components as a sensor, self-aligning, orbital space locator have been submitted on an industry competition to National Aeronautics and Space Administration. Competitive proposals for an optimized study of the space locator are scheduled for submission on July 31.

►Sperry Phonics Co. will receive an Air Force contract to supply the terminal guidance and landing system for the uncrewed Boeing X-20 Dyna-Soar space glider.

►Design for hard, high-frequency stressors systems for Minuteman ICBM missiles have been submitted to Air Force System Command's Ballistic Systems Division in an industry competition.

►North American Aviation's Columbus Division has adopted its Landing simulator facility to include approaches to and landings on a monoplane (specific), a portion of the modified "Eagle" Area A simulator panel, 32 ft. long by 10 ft. high, is mounted vertically. A television camera, mounted on a traveling tower, is controlled by a pilot sitting in a cockpit in a deflated man seat. The pilot observes the terrain projected on a screen in a television theater-type projector. The pilot can vary speeds and angles of approach, landing, takeoff and climbout.



**HOW DO YOU KEEP THE PEACE WHEN EVERYONE HAS A KEY?** This is the challenge given Bendix by the United States Arms Control and Disarmament Agency in its first contract to industry. Our assignment is to study on-site and remote techniques to monitor declared arms production and to detect clandestine production of strategic weapons such as long-range missiles and bombers. Such techniques could be implemented by an inspectorate established pursuant to an arms control or disarmament agreement. Scientists with experience and knowledge of international economy, industry, transportation or political science as well as operations analysts interested in joining this expanding area, write or call Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

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## Washington Roundup

### Space Committee Shifts

House space committee is about to be reorganized along lines which will enable the National Bureau of Standards and National Science Foundation to share the public spotlight with the National Aeronautics and Space Administration.

Reorganization will be followed by the departure from Congress of the committee's third ranking Democrat—Rep. Vicere Andrus. He will return to Brooklyn to run for city judge and it looks like he'll be re-elected to a Federal judgeship.

Rep. Andrus's congressional district has been merged with that of Rep. John Rooney, a Democrat who has served in Congress since 1943. Kennedy Administration officials, whose political strengths, shared Rep. Rooney the likely loss in a contest with Rep. Andrus, pressed Rep. Andrus to withdraw from the congressional race and assume his present office.

Departure of Rep. Andrus, who headed the subcommittee which reviewed NASA's research budget this year, elevates Rep. Edward Dunleavy to the subcommittee chairman. Committee Chairman George Miller intends to name Rep. Otto Fringer and Joseph Kiehl chairman of two new subcommittees of the House Committee, which controls annual savings of \$4 billion. A Defense panel, which the 1972 Defense Contracting and Standardization Act, Rep. Hobart H. Barden, will head the new Bureau of Standards and Science Subcommittee. Rep. Miller also is considering forming still another new subcommittee to investigate issues such as: drafting rather than concentrating on any one field.

The reorganization is designed to keep space spectators in perspective while maintaining the government's other important but extended scientific projects.

### McNamara Challenged

Defense Secretary Robert McNamara's process to reduce defense costs by \$3 billion a year (see p. 30) did not particularly impress Chairman Edward Hohenberg of the House Armed Services Subcommittee. Subcommittee Rep. Hobart H. Barden, who is a member of the panel, told the House Committee, "I have come to the conclusion that savings of \$3 billion a year in Defense cannot be had by the 1973 Defense Contracting and Standardization Act. Rep. Hobart H. Barden, who is a member of the committee's subcommittee and had been "giving a fair trial" to hearing speeches by procurement specialists, privately advised staff: "Just give up paper from the secret and most expensive bid studies he can afford to do."

House space committee will probably want to save money in the national space program as hearings slated to start next week.立法以及在政府预算中裁减科学预算的提案来自众议院科学委员会主席霍伯特·H·巴登，他告诉众议院国防委员会：“我得出结论，国防不能通过1973年国防采购和标准化法节省30亿美元。众议院国防委员会的成员霍伯特·H·巴登，他一直在听采购专家的讲话，私下里建议工作人员：“放弃秘密和最昂贵的投标研究。”

### Dr. Wiesner's Stand

NASA delayed its final assessment of the basic research decisions (see p. 32) for a week to satisfy Dr. Jerome Wiesner, White House science adviser, who has asked for more time to study the proposal.

President Kennedy last week nominated Wiesner as director of the newly established Office of Science and Technology, which will try to coordinate federal research activities. Once Wiesner is confirmed by the Senate, a House Government Operations Subcommittee will question him on such proposed budget reform reforms as reducing the number of the agency's paid by private funds doing follow-on research (AW, Feb. 9, p. 18).

House commerce committee hearings April 17 and 18 on aircraft noise will consist mostly of eleventh-hour petitions from the Chicago area complaining about the noise from O'Hare International Airport. The aerospace and regulatory agency subcommittees will not study the hearings. The full committee has been directed by a House resolution to file a report on aircraft noise by the end of the congressional session. But the rule to adjourn probably rules out hearings on infrared problems and solvents (AW Apr. 16, p. 38).

### Contractors' Protest

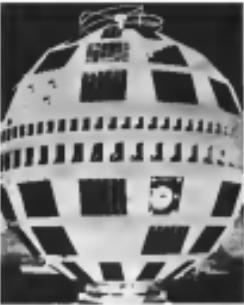
NASA is trying to show a better picture of where space dollars are going by requiring prime contractors to list the names and addresses of their subcontractors that manufacture agents. The most unnecessary paper work. Over 4,000 of them already have signed the Budget Bureau, which wants to approve the series, to prevent the plan. All NASA wants the contractors to do is fill in a postcard asking eight questions about their subcontractors of \$10,000 or more.

Senate and House science leaders are discussing a compromise bill to entitle government guaranteed loans for aircraft purchases of up to \$10 million for a single local aircraft center and up to \$15 million for a large center. The House science subcommittee approved a bill raising the loan guarantee limit from the present \$5 million to \$10 million, but did not consider the authority to include cargo aircraft.

—Washington Staff



QUALITY OF PICTURES RELAYED BY TELSTAR compares favorably with television pictures received. Two commercial ground stations—Vice President Lyndon Johnson, left, and by phone with AT&T official in his picture—is relayed via the satellite. Right, still photo of Telstar was relayed through the satellite.



## Telstar Performs Perfectly in Early Tests

First active communication satellite transmits live television and voice between U.S. and France, Britain

By Philip J. Klass

Washington—Bell System's Telstar active communication satellite last week performed perfectly in its first operational experiment, transmitting for the first time live television over intercontinental distances between Andover, Maine, and stations in France and Britain.

The French station at Pleumeur-Bodou in Brittany using a large horn antenna dedicated to the one installed at the Bell System's Andover facility, was the first of the two overseas stations to receive the Telstar television signal. It reported the quality of the received picture to be comparable to that from local French stations.

Through four hours later, during Telstar's 130-min. test, the French station transmitted a taped, humorously inappropriate 5-min. program which was received over the satellite both in the U.S. and Britain. The program was relayed live by two of the U.S. stations.

Quality of the picture received here was excellent, despite transmission from the French 500-km. sister to the 335 km. test in the U.S. Program note and related news to Jacques Massette, minister of post and telecommunications, and performances by several French entertainers.

On Telstar's next pass, the British having over the French interest which they had maintained an agreement between the two nations, beamed a live program to the U.S. Most observers agreed that the British broadcast, largely a discussion of international television by a panel of communication officials, was technically superior to the French program, although not as lively in content.

During the initial experiment, the 130 hr., 34 min. in the Telstar pass showed 37 min. of uninterrupted, high-quality service, relaying live television and voice between Andover and ground stations in Andover, Maine, and by phone to the Andover station. Local news appeared the first time between Washington and Andover, with signals being relayed to Telstar 49 times.

The satellite was launched by National Aeronautics and Space Administration at 8:31 a.m. EDT July 10 from Atlantic Missile Range by a Thor-Delta

vehicle into a 467-km. elliptical orbit which matched program elements with extreme precision.

Initial data from NASA tracking network exhibited an apogee of 3,380 km. and a perigee of 380 km., giving a period of 137.3 min. The cost of the launch, approximately \$2.7 million, was paid for by American Telephone and Telegraph

down, and later by the contractors with NASA Administrator James E. Webb and congressional leaders here. A major portion of the program was telecast by the commercial television networks.

At 7:45 p.m., as Telstar was approaching Spain, the French station reported that its reception antenna had picked up the satellite tracking beam. Two hours later the French station reported it was receiving the Telstar picture and voice signals.

The British station, which has a low-gain antenna, first received the Telstar signal at 8:00 p.m. in Shorthorn afterward. Andover transmitted a favorable photograph of the satellite, which was received by the British and French stations.

At approximately 5:00 p.m., the first sign of noise due to picking up radio radiation was heard in the Telstar audio signal, indicating that the satellite was passing the radio horizon. About a minute later there were sporadic intermissions. At 9:00 p.m. the Andover station transmitted the command which took down the satellite. The last experiment service period had lasted 37 min.—9 min. longer than had been anticipated from early computations.

Telstar was sighted by the Andover station during its next orbit at approximately 10:10 p.m. and was operated for approximately 30 min. during this pass, with transmission limited to voice communications.

The Andover Wave reporter had the opportunity to talk via the satellite for approximately 3 min. with another reporter located at Andover. The connection and establishment of the signal received in Washington enabled that month's experiment in local telephone conversation, with no evidence of echo or transmission lag.

Communication was carried on in normal fashion. The only distinguishing difference was the inability to hear one's own voice through one's telephone receiver in normal conversation, a characteristic of which telephone users are generally unaware. It was the reporter's opinion that this does not indicate speech modification, but rather prevents echo normally.

Telstar's next pass, received from the unanticipated Andover location, showed the attitude of its spin axis was almost precisely perpendicular to the ecliptic plane, as intended according to Eugene F. O'Neill, who directed the Telstar program at Bell Telephone Laboratories, which designed and built the satellite.

Telstar is the first of three different communications satellites which NASA plans to launch during the next two months. The Project Relay satellite, being built by Radio Corp. of America, is scheduled for launch July 14, while Statite, intended to be placed in orbit at synchronous altitude of 22,300 mi.,



TELSTAR COMMUNICATIONS SATELLITE received signals transmitted from Andover, Me. station then relayed them back either to Andover (1) or Holmdel, N.J. (2). Left, call-linked Andover with Washington, D.C. (3). Telstar transmitted television pictures from orbit which were stored in England (2) and France (4). Below, Telstar rests in a temperature and humidity-controlled test shop the third stage of the Delta rocket at Cape Canaveral Fla., prior to its launch for orbit. Right, round the satellite's exposure cover the transmitting and receiving antennas and block of all but one of each for pre-launch ground test of the satellite's communications path.





# USAF Balloon Achieves Endurance Mark

By Larry Books

**Washington**—An Army superpressure balloon which is capable of maintaining a constant altitude without dropping ballast broke all known flight records last week by remaining aloft 50 days during which it traveled from Bremerton to a point 120 miles northeast of Honolulu in the Pacific Ocean.

The flight, the last of a series testing the principle of long duration flights based at high altitude, was started by the Federal Communications Commission's tracking and recording network of radio stations, employing high frequency direction-finding equipment. It was made at 60,000 ft.

One previous flight reached out to west from Bremerton to 16,000 ft in the Western Pacific in 19 days. 5 hr, a duration of more than 60,000 hr.

As they rise, the balloons expand until they reach their final size and thereafter maintain constant volume regardless of changes in external pressure.

In each case, the 50-ft inflated capsule consisted of a series of increasing increments which televised data to the ground station. Temperature and pressure of the lifting gas were measured, altitude was measured and cruise in the upper stratosphere was measured. Ozone is considered a "tracer element" for giving the amount of solar and other radiation at the upper stratosphere.

A radio command receiver is also aboard to switch equipment on and off and eventually bring the balloon down. No attempt is made to recover payloads which come down at sea.

Scientists from the Air Force Cambridge Research Laboratories have been launching the 36-ft-dia balloons since early this year. One flight launched April 26 from Chico, Calif., traveled to

Colorado, Utah, at 51 days at a constant altitude of 70,000 ft.

The 65,000-ft level is used because there is less wind and density over most of the globe at these altitudes.

The principle of superpressure balloons is not new, but it is now until much lighter-than-air plastics were developed that this became practical. Most balloons of the superpressure type since World War 2 have been made of polyethylene. This material was found to be so heavy when made thick enough to resist the internal pressures necessary for the superpressure flight.

## Two-Layer Lamination

Mylar, which is the trademark of a du Pont polyethylene, proved to be the material first made the constant altitude balloons possible. It is 10 times as tough as polyethylene. The Mylar, 15 mils (0.015 in.) thick, is employed as a two-layer lamination. This is necessary to prevent gas leakage of gas through individual septa holes. By having two layers the holes are not lined up with each other and create a more perfect seal. The bag weight is 40 lb.

The superpressure balloon is a sealed, vertically laminated plastic cell that will float at a constant density altitude independent of temperature of the lifting gas. The balloon is inflated at 40,000 ft and remains at that level 8 days. Ordinary balloons have to drop ballast at 40,000 ft and must descend to 8,000 ft to maintain altitude at the gas tanks.

The plastic cell consists of 10 ft of lifting gas without significant change in volume. Internal pressure was, but was raised above the outside pressure. At floating altitude the skin stress was at high as 3,700 psi.

This type of vehicle is more efficient than the conventional, called balloons. Since they need no ballast, their endur-

ance is limited only by loss of gas by permeation of the bag material. By using as stable platforms for supporting equipment at the edge of space for prolonged periods, they can furnish more information than the short duration sounding rocket.

A development of the sounding rocket and the superpressure balloon has been used in the past. The "Rising balloon" was named from a sounding rocket at 250,000 ft to allow tracking for determination of wind directions and velocities at that altitude.

The launching at ground level, an altitude of 10,000 ft, of gas at 60,000 ft is pushed. When a conventional balloon reaches the altitude where it starts to "rise off" the excess gas and continues to rise until internal gas pressure and atmospheric pressure are equal, and the balloon loses all of the displaced air equals the total weight of the balloon and its buoyant gas.

During the day the sun heats the gas, causing some to rise off. After sunset the gas cools by radiation and the balloon is compressed. This causes a release of gas no longer required, the weight and the vehicle will descend until balloon is dropped. The next day the lifting gas will be at 60,000 ft again. A single ordinary balloon has to descend for only 74 hr period. The low densities that would be problematic long.

The superpressure balloon is tested by hot air means of lifting gas. Since the balloon volume remains constant and the weight is to be reported constant the same, the balloon always remains at an altitude of constant air density.

## Cloud Conditions

Cloud conditions can affect the internal pressure of the balloon. If it is floating over a cloud, and if a cloudless area is reached, the pressure will to a great extent evacuate the ball of gas balloons. On the other hand, if there is a cloud over below, the gas loses heat and the internal pressure drops. Thus, under some conditions there is little pressure variation, but under others the variation is greater.

In addition to high tensile strength, the balloon material must have the quality of being sealed tightly along its seams and holding that seal at the low temperatures encountered in the stratosphere, as well as at the higher temperatures at lower altitudes.

A series of tests in cold chambers proved that the best method of making the bag is to melt two sheets of the plastic to form a laminate. The balloons were manufactured by the G. T. Schindl Co., Minneapolis.



## Army Takes Delivery on First HC-1B Helicopters



First Vertol HC-1B Chinook helicopter to be delivered to the Army is test flown at the Vertol plant at Marietta, Ga., prior to ferrying to Ft. Rucker, Ala. Ship No. 8 will be production line 10, the first to enter Army inventory. Previous ships, some earlier on the same type, were accepted by military plant representatives and then brought back to Vertol for use in version test program planes or sent to Ft. Rucker for spin-down testing. None are listed to Vertol inventory and none are considered prototypes or Y models. All will go to the Army in the completion of the test program in production ships. Probable configuration of the USAF Vertol HC-1B (see model in drawing below) includes purple tail of additional tail.



## New Depreciation Rules Aid Industry

**Washington**—Equipment depreciation credit for the aerospace industry will be reduced by as much as 20 percent under a compromise tax bill passed last week by the Treasury Department to ease administration of the U.S. production plant tax.

Treasury Secretary Douglas Dillon estimated an industry would gain a \$3.6 billion increase in tax deductions for depreciation during the first year of the statute.

The statute has the useful life of equipment as the maximum calendar year set at eight years. Although in the past there has been no established norm for the industry, it is possible it has averaged 10 years. The same eight-year norm is set for electronic equipment manufacturers.

For aircraft equipment manufacturers the norm is set at 12 years, compared with an average of 15 years in the past.

Rebates under the reform may be taken by all companies whose tax returns were due July 12 or later.

There is a strong switch to the new accelerated method of depreciation. They must be compensated by accelerated equipment replacement programs.

Treasury released a \$30-million reduction in the tax liability of the air transportation industry for the coming year under the new depreciation rules.

## NASA Studies New Mars Flyby Spacecraft

Limited capability, lightweight alternative for two Mariner B spacecraft intended to be launched into Mars' orbit by 1966, as earlier study of Jet Propulsion Laboratory, which manages National Aeronautics and Space Administration's planetary exploration space program.

Consideration of a relatively Mariner which would be substantially lighter than the Mariner B spacecraft now in development at JPL, was made necessary by the long delay in the development of the intended Agena-Centaur boost vehicle and in the likelihood that each version of Centaur will be both overpriced and under threat.

Known to be chosen as the Mariner M (M for modified), the relatively Mariner B spacecraft probably would have no an apogee weight of between 416 and 500 lb., compared with the estimated 1,150 to 1,750 lb. required weight for a Mariner B vehicle. Mariner M is designed for Agena-Centaur boost, has dual VHF/UHF capability and can operate in small planetary orbits. The lighter weight of Mariner M is intended to reduce the spacecraft, move and then maneuver back to JPL's Deep Space Instrumentation Facility.

Results of the Mariner studies are intended to provide a better understanding of the geology of the planet's surface as part of the overall objective of the Mariner program to study the planet's atmosphere, surface and data storage media. Mariner M may carry an infrared filter radiometer for studying particulate species lines in the planet's atmosphere. Two low-power cameras are located at each selected planetary approach in the Mariner program; at least two Mariner M spacecraft would be built if a firm decision is made to go ahead with this approach.

As a result of Centaur's nonavailability, it now appears probable that NASA and JPL will make these new changes in its Mariner program.

• **Mariner orbiter**, which was proposed as a modified Surveyor spacecraft to be launched by Agena-Centaur, will be lost in its first version—the lightweight stripped-down vehicle launched by Atlas A.

• **Five Ranger spacecraft** can be added to the lander-based lunar project to get additional information that a maximum amount of data about the moon can be obtained for the Apollo program (AW, July 2, p. 34). A number of proposals have been made for possible payloads for these vehicles.

The value of the Mariner M spacecraft is undergoing study now and probably will be completed for at least several weeks.

The Mariner 1 and 2 studies are heavily oriented basic Range spacecraft, but this vehicle would be suitable for a Mariner mission because of sufficient electrical power and moderate temperature control.

In addition to the possible redesign to the Mariner M spacecraft for the Mars opportunity in 1966, the next Venus

study to take place in early 1965, again will use the lightweight Aria, Ariane, Bionaut or Mariner 1-type spacecraft.

Should Mariner M be adopted, the Mariner B project which was intended to start in 1964 probably will be pushed back to the next Venus opportunity occurring in 1967.

Mariner M can carry a single channel television camera at fixed wide angle and narrow angle camera system. The camera system is expected to obtain one to five kilobits resolution pictures of the planet from a distance of between 10 to 50 kilometers from Mars during flyby. Pictures will be stored on board the spacecraft, moved and then transmitted back to JPL's Deep Space Instrumentation Facility.

Results of the Mariner studies are intended to provide a better understanding of the geology of the planet's surface as part of the overall objective of the Mariner program to study the planet's atmosphere, surface and data storage media. Mariner M may carry an infrared filter radiometer for studying particulate species lines in the planet's atmosphere. Two low-power cameras are located at each selected planetary approach in the Mariner program; at least two Mariner M spacecraft would be built if a firm decision is made to go ahead with this approach.

As a result of Centaur's nonavailability, it now appears probable that NASA and JPL will make these new changes in its Mariner program.

• **Mariner orbiter**, which was proposed as a modified Surveyor spacecraft to be launched by Agena-Centaur, will be lost in its first version—the lightweight stripped-down vehicle launched by Atlas A.

• **Five Ranger spacecraft** can be added to the lander-based lunar project to get additional information that a maximum amount of data about the moon can be obtained for the Apollo program (AW, July 2, p. 34). A number of proposals have been made for possible payloads for these vehicles.

• **Five Mariner** (Mariner 1 and 2) vehicles, larger than that of the Venera-DV vehicle.

NASA is considering that although it may develop a bit more powerful Mariner to boost interplanetary missions beyond Apollo and to carry the Ingenuity package that would support exploring subsurface of the lunar surface, NASA may settle that, to assume its proper role as the lead agency in the human inventory, NASA must be able to propose to compete vehicles at least twice as heavy as those that can be imagined in G-3. It is estimated that G-5 could cost 200,000 lb. in its most advanced or boost orbit configuration to accomplish the Apollo mission.

For this reason, White said, "we will not just add another vehicle to the under contract." An formerly commented by NASA, NASA's first stage would be powered by eight Rocketdyne F-1 engines with a total thrust of 72 million lb. Its second stage would consist of four M-1 engines, a new liquid oxygen/hydrogen kerosene 1.2 million lb thrust power plant to be manufactured by Aerojet General Corp.

Although NASA intends to continue M-1 development, the question of how to fine tune the program now is being studied. Determinants undoubtedly will not agree two of three interests.

Meanwhile, in defining actual development of the Nova boosters for the first two runs, NASA began to look out past its funding requirements that might slow Apollo program progress. According to NASA Administrator James Webb, there is little point

invention studies won't get under way by p. 25. Currently NASA is weighing options of programs to develop a nuclear-powered space stage to be used with the first Nova boosters.

Whether to develop a lunar lander vehicle at the subject of still another NASA study that is expected to come into its eighth month this year, and the most prior to the first of a family of six nuclear lander landing craft that could collect scientific data on the physical condition of the lunar surface.

## NASA Is Authorized \$8.3 Billion by Senate

Washington—Senate last week approved the bill authorizing the National Aeronautics and Space Administration to spend \$5,825,512,520 in fiscal 1963—about \$33 million more than the space agency originally requested and \$28 million above what the House authorized (AW, June 25, p. 36). Deliberations will be resolved in a conference between the Senate and House.

The Senate approved the NASA authorization after reporting two round events offered by Sen. William Proxmire (D-Wis.). One amendment would have required NASA to let contracts through formal advertising to the aerospace industry, while the other would have established a presidential commission to study the effect of the space program on the U.S. management pool.

Proxmire said that without more competitive bidding, NASA contracts would result big company bigger and cost the nation unnecessary money. The NASA administrator, under the round event, would have to file a written justification every time he awarded a contract by negotiation. The General Accounting Office would have access to the publications. The amendment was turned over to other agencies, mainly Defense Department, which, in turn, compromised 94% of it to industry.

• **California Institute of Technology**, which has 10% of the space agency's management money, was deleted and SGR.

• **Contract and research grants** to non-government organizations accounted for 4% of NASA's procurement.

Contracts were awarded in NASA's in this manner: 4% by advertised bid, 42% by competitive negotiation and 49% by non-competitive negotiation. The non-competitive awards were follow-on type contracts.

The largest share—45% of NASA's contracts were won and placed for the firm ranged from 5.01% to 9.35%, and averaged 4.59%.

The big budget NASA awards during fiscal 1962 were:

• **McDonnell Aircraft Corp.**, \$25 million initial letter contract for developing

## Program Names Dropped

Air Force Systems Command's Space Systems Division has dropped completely the use of project names previously associated with specific programs. The following names designations have been substituted for their program code names:

■ <b>Molniya</b> (satellite defense space system)	2100
■ <b>Smart satellite interceptors</b>	6100
■ <b>Discoverer</b> (optical space experiments)	6125
■ <b>Large solid motor program</b>	6150
■ <b>Titan 3 (space) launch</b>	6245
■ <b>Agave</b> (upper stage and spinoffs)	6800
■ <b>Brontosaurus</b> (orbiting space station)	6950
■ <b>Vela</b> (radio for detection of nuclear explosion)	6980

The names designations were substituted in compliance with Public Affairs Committee Directive 5.2010.03 issued in the military services in the Office of the Secretary of Defense.

For existing programs Space Systems Division, this enforcement employer, said at concluding deliberations of programs, is unaffected. Comparison of latest SSD report with chart showing program name numbers, with either that of organization telephone number, the program under popular names reveals names of entities personnel associated with each type of designation and codes identified in the actualized program name.

## NASA Procurement Total Rose 85% In First Half of Fiscal 1962

Washington—National Aeronautics and Space Administration last week reported a 15% increase in the dollar value of procurement for the first half of Fiscal 1962, compared with the same period last year. The total \$64.6 million for July December 1961 was \$230 million more than the \$314 million for July December 1960.

• **North American Aviation's Rocketdyne Division**, \$73.7 million for development of the F-1 1.15 million lb thrust engine, making an additional procurement total of \$97.6 million. The total budget is estimated at \$174.4 million.

• **Douglas Aircraft Co.**, \$13.3 million for development and fabrication of Saturn S-4b vehicles and ground support equipment, making a cumulative total of \$41.5 million for the program. Estimated final cost is \$70.7 million.

• **McDonnell**, \$11.1 million for the Mercury program using the cumulative total of \$174.4 million.

• **Calspan Institute of Technology**, which has 10% of the space agency's management money, was deleted and SGR.

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The largest share—45% of NASA's contracts were won and placed for the firm ranged from 5.01% to 9.35%, and averaged 4.59%.

The big budget NASA awards during fiscal 1962 were:

• <b>Rocketdyne</b> , \$9.9 million for the H-1 engine for Saturn, making a cumulative total of \$21.4 million. Total cost estimate is \$17.3 million.	42
• <b>Long-Tissue-Vought</b> , \$8.5 million for the Sonti program, making a cumulative total of \$17.1 million.	43
• <b>Ames Research Corp.</b> , \$6.1 million initial contract for Nova underground rocket motor engine.	44
• <b>Westinghouse Electric Co.</b> , \$4.6 million for Mercury tracking and ground control stations, making a cumulative total of \$65.8 million.	45

## New C-5, Spacecraft To Be Studied As Backup to Lunar Rendezvous

Washington—Development of a new two-man spacecraft and a single purpose lunar version of the Saturn C-5 vehicle to launch man on a direct trajectory to the moon will be studied by National Aeronautics and Space Administration at a backup rendezvous for accomplishing moon landing.

Although NASA confirmed last week that the Apollo lunar exploration mission would be based on the four-hour orbital rendezvous technique (AW, July 9, p. 25), it also said that direct ascent and earth orbit rendezvous would be the subject of continuing feasibility studies. Both would involve the new, relatively small spacecraft which in concept resembles the configuration of Apollo more closely than that of the original Gemini because it incorporates two modules.

NASA plans to request industry to pitch this week on a lunar excursion vehicle—the big dog that would carry two of the three Apollo astronauts to and from the moon's surface while the mother spacecraft remained in low

# McNamara Says Economy Steps Could Save \$3 Billion Per Year

Washington—Defense Secretary Robert S. McNamara has outlined a series of actions he has taken that he said will lead to annual savings of \$1 billion per year through more efficient management, more competition in buying and elimination of duplication in procurement by the military services.

These economies are expected to save \$778 million in fiscal 1963 as cost and work up in the \$1 billion figure in five years.

The savings would not necessarily result in a lower defense budget, he explained, but could be used to buy more military strength.

McNamara made his cost-cutting program July 5 in a memorandum to President John F. Kennedy. At a press briefing he presented charts illustrating savings already taken.

## Example Cited

An example cited in the services' inventory standpiles. Every stand has been transferred to meet the needs of other services rather than supplied through new procurement. In one instance, the Air Force needed aircraft-plate heating for use as overhead of aircraft engines. The aircrafted heating was found in Navy stands at a price of \$7 each.

The inter-service transfer of these items resulted in a saving of \$26,000, the memorandum said. About 4,500 of these transfers take place monthly, it added.

By re-evaluating inventory levels, it was possible to cancel \$25 million in new procurement in fiscal 1962, the report stated, and greater reductions are anticipated in future years.

## Value Engineering

Each military service was encouraged to develop "value engineering" in which less valuable materials are used in place of more expensive ones. One example given was the H88-2 helicopter pilot seat. By switching from use of steel to aluminum and changing the design, the unit price was reduced from \$54.45 to \$41.00. Material for a missile test bearing wheel, with a designed service life of 2 years, was changed from machined aluminum steel to oxidized plastic, achieving a price reduction from \$175.00 to \$2.00.

Similar examples were cited of price reduction for replacement parts gained through competitive bidding. Among these were aircraft windshields which cost \$666.72 for a sole supplier under and \$441.00 under competitive bidding, and an amphibious

vehicle whose price was reduced from \$43,300 to \$31,000.

McNamara said that the drive to reduce the total annual gross cost of cost-plus-fixed-fee contracts is continuing.

The savings reached a peak of

10.5% of all defense contracts in the first nine months of fiscal 1961, while during the corresponding period of fiscal 1962 it was 3.5%.

## Other Economy Moves

There are other areas which will produce savings according to Defense Secretary McNamara.

### • Simplification of purchasing procedures

• Standardization of engineering procedures. Throughout the Defense Department, 16 different forms and systems are used, resulting in the necessity of removing 298,000 repository entries when one service buys from another service.

### • Standardization of shopping documents. At present, 90 different bills of lading and forms are used.

• Consolidation of all long-distance communications land line facilities in the U.S. and overseas. All overseas networks will be integrated.

• Freight traffic coordination through a Traffic Management Service.

• More efficient equipment maintenance through reduction analysis of every part failure on aircraft.

• Removal of real estate and installations which do not meet present or future needs. Some 250,000 acres of land have been sold and returned to tax rolls. 28 plants with commercial potential have been put up for sale and 42,000 per square foot have either been released or re-assigned.

## Infrared Beam Aids Space Communications

Important discoveries which open up an entirely new portion of the electromagnetic spectrum for line-of-sight communications, and which may permit non-communications with space craft during reentry when radio links between the earth and the vehicle are blocked by an ionized plasma sheath, have been made at the Massachusetts Institute of Technology's Lincoln Laboratory.

Scientists there have generated an extremely intense beam of infrared radiation, with a communications bandwidth of at least 100 Hz, by applying electric power to a silicon structure (semiconductor) diode. This is based

on gallium to handle 20 full-quality television channels or 30,000 voice channels.

The radiation produced at 100 nanometer wavelength at a near infrared wavelength of 8600 angstroms, when the diode is cooled to a temperature of 77K.

At room temperature the radiation is about 100 angstroms wide and centered at about 9,300A.

Using an experimental setup, Lincoln Laboratory scientists transmitted a high-quality TV picture over a distance of 275 ft., using the radiation that was produced by a gallium arsenide diode.

With modest infra-red images to 30 cm. or more appear possible. Because the beam energy is concentrated in a narrow portion of the spectrum it can be used for daylight as well as night operation, or for collecting signals when no source is bright except in the operating wavelength.

Unlike the laser (optical source), the present gallium arsenide diode output is not coherent radiation. The signal is impressed on the beam by means of oscillations, or "ringing" by the magnitude of current flowing through the diode.

Both the power intensity and conversion efficiency increase as the operating temperature of the diode is decreased. Experimental diodes used in tests have exhibited conversion efficiency of nearly 100% at a temperature of 77K, generating peak output power of about 100mW. This is equivalent to a power density of 2.14W with one square centimeter of diode working area, comparable to the undoped power of the sun's surface, but generated in a much narrower spectrum.

The new infrared generator can potentially change the communications system which can penetrate the ionized plasma sheath of a space capsule during reentry, or for communications between space vehicles. The infrared radiation generated by other means may be subject to absorption by the atmosphere, particularly by clouds and particles in the atmosphere.

However, the energy it generates is the non-ionized region which makes the alternative that does not absorb at larger wavelengths.

The new development might also find application in infrared proximity-warning-collision-avoidance systems. One of the problems associated with past attempts to develop an infrared anti-collision system has been the limited range achievable using previously available infrared sources.

First disclosure of the new diodes was made last week at the Solid State Device Research Conference in Dubuque, N. H., by R. J. Keay and T. M. Quist of the Lincoln Laboratory applied physics group.



"Preliminary 7 Blue GM at Command" (background by E. D. Albrecht)

Below, for twenty years a leading source of resistance wire heating blankets, in a specialist organization dedicated to our objectives... application of controlled heat. Its products are found in Cape Canaveral and in lonely radar outposts in the frozen North. Safeway units are serving dependency on today's latest communication and military systems. In civilian, residential, and ground support equipment... in manufacturing equipment in plants... in 400 areas of communication

applications and even in laboratories.

Resistive heat elements are available in many and varied insulating materials and are designed and produced in wires or strings, flexible or rigid units and can be molded in various any plane or contoured shape.

It is needs connected heat find the "S" can be almost anything, with the best electrical representation limited only by the imagination above and year longs of Safeway's full-of-heat blanket.

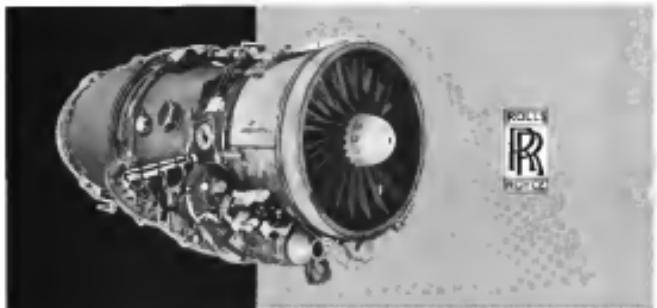
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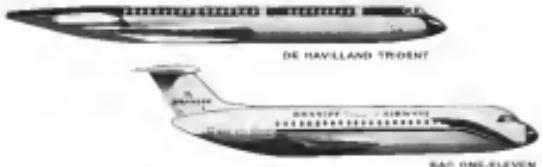
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# ROLLS-ROYCE SPEY BY-PASS JETS

powering short and medium haul airliners



The Spey, based on twelve years of Rolls-Royce experience with by-pass (turbofan) jets, is now flying in the de Havilland Trident and has also been selected to power the new BAC One-Eleven. The Spey's economy of operation is an inherent factor in the low operating costs of these aircraft, both of which have already been ordered by well-known airlines.



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## Apollo Service Module Propulsion Test

First test of the Apollo service module propulsion system, developing more than 20,000 lb thrust, was conducted late last week at the Aerojet-General Corp. plant in Azusa, Calif. Testing duration was to exceed 9 sec.

A follow-up version was to be fired in the first test of the new storable-propellant engine, which Aerojet is developing under contract to National Aeronautics and Space Administration (AW, Apr. 23, p. 25).

The test had originally been planned for a week earlier but was delayed due to minor modifications to meet test requirements.

The Apollo service module engine is required to make a minimum of six state-to-orbit maneuvers. It is intended to perform initial orbit, perihelion correction on the way to the moon, establish the lunar orbit, update the vehicle's account for earth return after recovery of the lunar landing vehicle, perform mid-course correction on the way back to earth, establish an earth orbit, and finally deorbit the Apollo command module for re-enter and landing.

Test-burning time will be of at least 13 sec. for operational engine.

Propellant tank design of different sizes are being considered. No decision has been reached on whether to use the oxygen tank itself in an operational configuration.

Propellant combustion is the same used in Titan 2. The fuel is an equal mixture of hydrazine and unsymmetrical dimethyl hydrazine (UDMH), and oxidizer is nitrogen tetroxide. The nozzle shell is made of titanium, and nozzle cutting is path-regression and parts relative.

## Spey By-Pass Engines Set for Fokker F-28

Amsterdam—Planned Fokker 1-25

41-in-60 passenger short-haul jet transport will be powered by two variable-Lagminated Rolls-Royce Spey Junior B pass engines with a maximum takeoff thrust of 6,000 lb each.

Selection of the Spey engines is the final design parameter for the F-28, which could begin prototype flight testing in 1965 if government approval for the project can be obtained this summer (AW Mar. 14, p. 15). The Dutch government now is considering a Fokker request for an estimated \$50 million model to complete development work and carry the aircraft through prototype stage. An agreement this summer, however, would permit redefining delivery of F-286 under present scheduling.

Competitor of the de Havilland Spey.

Fokker's consideration is the British

Siddley BS75, which also is in the 6,000 lb thrust class. Maximum takeoff thrust of the Spey Junior will be 7,500 lb.

A Fokker spokesman said last week that the two-engine configuration will be capable of lifting a fully loaded F-28 of approximately 30,000 lb maximum gross weight from elevations of less than 1,000 ft at flight in temperatures of up to 95°.

## News Digest

Air Force ATLAS B intercontinental ballistic missile was fired from Vandenberg AFB, Calif., 7,000 mi to the Philippines Sea, 700 mi east of the island of Mindanao on July 12. This was the first reported ICBM fired over the Pacific Ocean. Range to travel from the missile's launch point, which is 3,300 mi from Vandenberg.

## One Tiros Camera Fails

Metone angle television cameras are to be installed by the Titan 3 weather satellite launched June 19 (AW, June 25, p. 36). One stopped transmitting pictures. National Aeronautics and Space Administration has not yet determined cause of the failure.

About 75% of the 4,700 pictures or 2,000 to 3,000 frames below the equator were received in quantity. All of the work 40-mile angle cameras on the satellite have transmitted 5,100 pictures, most of which are in achieving the world record and accuracy of Typhoon 1 in the Western Pacific area.

Additional comments relating to astronomical data and design information necessary for the medium-vacuum propulsion version under development for a high-speed, low-altitude

spacecraft will be conducted by Cheon Vought Division, Long Beach, Calif., under a \$2.6 million contract from NASA's Astronautics Division.

Passage to Holland: DH1125  
twin-jet executive transport will not be in flight for a week and first flight probably will be made in mid-August. Airplane won't have flown at least 10 hr by that time for showing at the annual Farnborough Air Show Sept. 3.

Titan 2 storable propellant intercontinental ballistic missile made its third successful test flight 5,000 mi down the Atlantic Missile Range July 11 with the instrumentation payload set near Ascension Island in the South Atlantic Ocean.

Institute of Radio Engineers has voted to merge with the American Institute of Electrical Engineers to form IEEE in January. The new organization, larger professional engineering society in the world, will be called the Institute of Electrical and Electronic Engineers.

Avon Aircraft and Canadian Applied Research Division of Hawker Siddeley of Canada Ltd. have been purchased by de Havilland Aircraft of Canada, Ltd. Hawker Siddeley will concentrate on other phases of its operations and will retain its Divids engine division and Canair aerofoil plant.

## Final Shatlov Ruling

Washington—Administrator Donald E. Meeron has formally ruled against an insurance space flight rights action by his Anglo-Eastern action, the National Aeronautics and Space Administration, on test flight to be made by a crew member in an aircraft carrier in the South Atlantic.

Final decision to proceed the Air Force cargo ship Minotaur flight was made by Dr. Robert E. Gilruth, director of NASA's Manned Spacecraft Center, and Dr. Max Mays' lawsuit action was answered by confidant Dr. Paul Doherty. White, two teams of legal specialists convened in Air Force and MSC's own plutonium (AW June 18, p. 21).

Doherty's rationale was that Max Mays' claim against, however strict liability, might prove a hazard since "the potentially harmful circumlocution of our most severe space flight operation." However, NASA Administrator James E. Webb and his legal team say Max Mays' suit is being conducted as a "desperate" effort to force an insurance space mission and that the test flight will be made later.

Meanwhile, Max Mays is taking an unusual new place and operational responsibility in several space flight research programs undertaken by NASA.

## Subsidy Bid Viewed as Merger Strategy

**Eastern appeal seen as move to dramatize economic plight, hasten CAB approval of union with American.**

By Robert H. Cook

Washington—Filing by Eastern Air Lines for \$23.5-million subsidies last week is being viewed as more than a move designed to hasten a Civil Aviation Board decision in the current American-Eastern merger proposal.

Each point cited in the subsidy application emphasizes Eastern's falling profits aggravated by the current Flight Engineers International Air strike (see page 41). The carrier apparently hopes that might influence CAB to judge the merger case on the basis of Eastern's financial need as a counter similar to its decisions in the United-Capital merger and the Hughes Tool Co. control of Northeast Airlines (AW July 25, p. 48). Observers contend

These observers also believe that it is virtually a foregone conclusion within the airline industry that the CAB will grant any airline subsidies in light of President Kennedy's report to Congress that such relief aid for funds be denied.

Eastern's competition in its routes is also emphasized by Eastern as a major reason for its reduced earnings and the need for heavy subsidies to cover costs and profit for the balance of this year.

On that point, opponents of the American-Eastern merger say there has been a healthy traffic gain in Pan Am, competition because of the strike. This could be confirmed in part that Eastern's charges of "excessive competition" are not entirely valid but that in such markets as New York-Florida the CAB should eliminate the competition of American. American, Eastern and Northeast Airlines at Northeast as it stands with the former having and control of Hughes Tool Co. would further entrench competition and affect Pan Am through this route.

Although Northeast showed a traffic decline in June by 4.47%, the carrier, as far as month, was experiencing heavy gains as a result of improved schedule frequency and an accelerated advertising campaign resulting from Hughes Tool financial aid. Meanwhile, Pan Am traffic apparently was being handled mainly by Eastern's competition as of June 30, although there was a slight change of seats on the San Juan and Bermuda routes.

These are Eastern's basic arguments for subsidies.

\* Competition over Eastern routes became in heavy between 1955 and 1959 that the carrier's total revenue passenger miles dropped 17%, and Eastern has had additional competition in 75 of its top 100 markets. These 75 man-

ned for the industry as Table 1 and scheduled to expire on July 11.

\* Eastern contends that it must receive the money now to "improve its competitive position" in the nation's largest airline service, airline transportation, or in a dozen foreign markets which would be profitable without extensive government. To support this point, Eastern said that it serves 40 cities which generated a revenue total of less than \$1 million last year plus an additional 17 that produced a revenue average of less than \$500,000, pointing out that its long-haul, high-density markets are in effect subsidizing the less profitable communities.

Eastern estimated it would have cost the government \$754,000 in February if these smaller points had been as a fully subsidized local service under rate. Attempts to transfer a few of these cities to local service carriers have failed. "Inasmuch as CAB has jurisdiction over these cities,"

\* Mutual and private, under which competitors would share with Eastern a part of the revenue that gains as a result of the Eastern strike, are not available to the airline because CAB has not issued a final order on the Mutual Aid Pact which must be approved by the Board each year. CAB policymakers say that Eastern is free to accept such funds under its terms, says the panel that that is to be determined if the Board grants renewal of the pact. Eastern said that the pact provides the minimum sufficient to cover its costs.

\* Strike by FEIA has shut down Eastern three times since October of 1955 and the airline suffered an 18-day "Shuttle strike" by the Air Line Pilots Association in 1959. The airline termed the current FEIA strike "unprecedented" and beyond its control. It estimated its losses at \$250,000 in a direct result of the strike. If so, the strike is settled in the near future it will probably "decrease any chances of Eastern's living in the black in 1962," the airline said.

Eastern's requested subsidy, based upon a 3% rate of return on investment, was calculated as an expectation that the carrier could have maintained an average short-haul load factor of 52% for the balance of the year. Revenues would approximate \$149.8 million as opposed to an average of \$151.7 million. The requested subsidy would allow a profit of \$2.5 million. Discretionary costs on the airline's aircraft totalled \$79.4 million for the first six months of the year and were \$5.6 million by June, \$3.3 million in July.

### Maytag Stock Sale

Present holding of Leon R. Sterns, Jr., at National Airlines common stock have dropped to 15% with the sale of 100,000 of the 199,128 shares he bought in April from George T. Baker, the airline's founder.

Proceeds of the stock was identified as being used to National Airlines to pay a portion of Maytag's in the purchase, and the stock sale was understood to be part of the arrangement.



VC.10 Flap Arrangement Detailed in Flight Photo

Photo taken during flight of the Victor Airways VC-10 freighter transport shows details of flap operation and tail section. Note leading edge slats and Fowler flap used for slower approach speeds. Tail section is hinged like device, installed only for flight tests which also pilot if the tail section is too low on descent. To date the aircraft has flown a total of 2 hr. 9 min. in three flights, possibly for pilot familiarization (AW July 8, p. 29). Flight will resume this week after grounding for installation of flight test instrumentation.

## ALPA, Southern Appeal CAB's Order to Resume Contract Talks

Washington—Both Air Line Pilots Association and Southern Airlines have asked the Civil Aviation Board order that would force the airline to resume bargaining with union pilots who struck 25 months ago to be suspended last of its operating certificate.

In a conclusive finding issued July 7, the Board concluded in press release, "The Board's order to resume bargaining with ALPA or罢工飞行员 or re-creation of its authority to engage in air transportation" (AW June 4, p. 41). The CAB's then-Domestic division found thewrights while its non-Represents group in a sharp, 26-page report.

Southern's challenge to the Board order was filed July 6 in the U.S. Circuit Court of Appeals, New Orleans, and requested a review of the legal and wrong employed in CAB. The main issue, ALPA said, is the U.S. Circuit Court how to read the Board's order that stipulates right to have grievances resolved under Robert L. Ladd, Air pilot contract and that to do in contribution "improve position and an overall mutual understanding with protected rights of employees."

Earlier in its opinion the Board's members said that the extensive nature of Southern's position indicates that "an

element of positive writing and desire to encourage union activities is present in the airline's thinking. Should Southern continue to insist on its original demands, it would not be bargaining in good faith, the Board's majority stated.

The dissenting Board member countered with this reasoning: "ALPA through its own negotiations in accept a portion of its economic demands, which it ultimately found to be reasonable, Southern should carry a load from which those two are to be relieved. As a result, the union's elected to strike. But when this Board and South can had concluded absent an entire strike notice by losing other pilots ALPA when and then, chose to order its members back to work. Its conditions for doing to request the discharge of all 100 replacement pilots hired by Southern and no reprisal against ALPA members "who had engaged in conduct, assault, assault, etc." the majority said.

Describing the majority opinion as "empty," the Board's Republicans warned that it would set an "inadequate precedent" and "lengthen" proceedings after CAB's function of the courts permitted it to stand.

# New England Senators Protest Quality of Service by Northeast

Washington—Eight New England senators last week announced that they would not support Northeast Airlines in its attempt to renew its Florida operating authority unless they are assured that New England will get better air service.

The senators were protesting the airline's attempt to cut losses on its New England system by eliminating non-priority points or serving two or more non-density points through one aircraft.

One of the group, Sen. Nitze Gossen (R-N.H.), told CAB Economic Watcher W. Bratt last winter that Florida renewal must be considered in the light of its effect on Northeast's New England operations (AW Jan. 15, p. 42).

Without its Florida routes, Northeast might have to go out of business or receive subsidies.

## Heeding Requested

At the recent hearing in the renewal case last week, Northeast, Eastern, and National airlines had threatened to sue if a decision was then ruled by CAB in a 30- to 60-day postponement in order to bring their testimony and exhibits up to date. Bratt mentioned the unusual case hearing until July 24.

Edgar C. Dill, attorney for Northeast, told firms that Hughes Tool Co., whose general of Northeast has been approved (AW Jan. 25, p. 48), had contacted staff to the program to revitalize the airline.

• **Senate** now has a loan guaranteed by Hughes Tool for the airline.

• **Eastern** extension of due dates on Northeast permission to several months.

• **Pennwest** received permission to re-open three of five cities.

• **Subsidies** will end if Hughes Tool has against Northeast—a new about \$11 million—in the case of the termination of its contract.

• **Undisclosed** all cut deficits caused in the airline after June 30.

Northeast's principal creditors have until July 31 to approve the revitalization program.

## Control Reversal Sought

In related action last week, Eastern and National, in a last-ditch effort to stymie the approval of Hughes Tool acquisition of Northeast, asked CAB to re-hear, reconsider, or grant re-consideration of the Northeast-Hughes Tool Control Case.

Eastern intended the Board that

under the Federal Aviation Act, could cause require a hearing and could void the existing CAB order approving control. CAB had said, "no further work was developed on the record, as panel rule Hughes control would be granted," since the alternative would be robbery or bankruptcy. In the meeting, Eastern said, no hearing was granted.

Northeast said the flew in the North and Hughes Tool met in a CAB "post-mortem" that Northeast's survival as a public interest, Northeast said, that participation could have been granted if Hughes Tool's activities could be shown to be sufficiently improved that by continuing Hughes Tool was agent of Texas World Airlines in its time, parties at opposition to Hughes Tool control of Northeast were never allowed that opportunity (AW Apr. 16, p. 40).

• **Blatant** agreement between the U.S. and Japan had been made by negotiation, but the U.S. withdrew when the East Asia border was sealed by the Communists (AW Sept. 4 p. 40).

## FAA Criticized for 707 Statement

Washington—Sen. Warren G. Magnuson (D-Wash.) has charged that the Federal Aviation Agency "exceeded its statutory authority" when it said the loss of a nuclear power system built into a new airplane in the May 10 draft of a Boeing 707.

Under the Federal Aviation Act, only the Transportation Department is authorized to determine the cause of the probable cause of an accident.

Magnuson, chairman of the Senate commerce committee, and in a Senate speech "when individuals in government apparently assume authority not delegated to them, their words are as though accepted by the general public," because they "ring with official sanctity."

Prompting Magnuson's remarks was an alert bulletin issued by FAA on June 10 to all U.S. and international operators of the 707 (AW June 16, p. 37).

This telegram explained that the agency's investigation of the accident, which cost \$5 million, "indicates possibility, repeat possibility, that left roll control system caused a control system fault which resulted in left roll control system failure" due to malfunction of older lead seals.

Enter in the message, George C. Poll, director of FAA's flight standards service, emphasized that a complete CAB investigation of the accident was not planned and that the FAA bulletin was "to see us as attempt to pre-empt CAB findings." Rather, Poll said, it was to alert the airlines of FAA's intended action.

The FAA safety Administrator V.E. Hiltz, however, then cast sharp doubt

## Moscow-Cuba Route

Washington—Soviet Union's state-owned airline, Aeroflot, last week took the last tangible step toward opening its Moscow-Cuba route. Plans for the route were originally reported by Aviation Week (AW Mar. 16, 1961, p. 41) and later endorsed in Moscow by Anatolii's chief, Colossal Comsat Yevgenii Logachev (AW Mar. 22, 1961, p. 41).

A proving flight, using the long-range Tu-114 long-haul transport, was scheduled between the two points late last week in preparation for regular service. Plans for South Atlantic service to Latin America (AW June 21, p. 30) and the North Atlantic equivalent are being developed simultaneously during the next few years, with the intent to produce a major new route in the South Atlantic.

It is not clear if Hughes Tool's activities could have been granted if Hughes Tool's activities could be shown to be sufficiently improved that by continuing Hughes Tool was agent of Texas World Airlines in its time, parties at opposition to Hughes Tool control of Northeast were never allowed that opportunity (AW Apr. 16, p. 40).

• **Blatant** agreement between the U.S. and Japan had been made by negotiation, but the U.S. withdrew when the East Asia border was sealed by the Communists (AW Sept. 4 p. 40).

The service is considered a significant step toward the opening of the route, and the number of routes participated in the Mutual cooperation studies reached an early four-line limit to single-engine aircraft (AW Dec. 25 p. 24).

Airlines consider the service unusual, although not too encouraging. Only 10% of the total auto traffic is making trips of over 800 mi. are considered likely for diversion to air. Elsewhere, the 15% would increase to 20% in 1965, 25% more than the 30 billion car-miles flown each year.

Other conditions of the survey include:

- Approximately 42% of the 135 million auto trips made are at an auto trip of at least 400 mi. in 1961, while only 10% are over 800 mi.
- Total of 75% of auto travelers and their vehicles will be in car pools if air and road rates were comparable.
- Only 40% of auto travelers even consider air transportation.
- Total of 40% of auto travelers could not even estimate comparative costs between air and road trips of equal distances.

• About 10% of those interviewed expressed a fear of flying (AW May 21, p. 47). This figure is low, survey participants feel, because of human reluctance to admit fear. It is felt the figure could be justifiable, tripled in the survey.

• Glauco Goss and industry officials believe the Oceans Research Institute's findings of the expectation that only 20% of the nation's population has ever flown a commercial airline. Survey figures show that 27% have been by air, 25% more than 10 years.

The largest single factor in the choice of auto travel over air is the availability of the car at destination, an advantage cited by 60% of those interviewed.

• **Airline** executive decision-making action committees should have been formed by FAA if the potential problem was of an emergency nature.

## Survey Questions Auto Traffic Potential

By James R. Ashlock

other session tendered close the auto and 41% liked having compensation along. 30% favored doing 37% said to set face auto vehicles to type and 25% preferred the flexibility of type and amount of luggage that can be carried by car.

The airline backlog up to this point does not meet the requirements of the auto industry. Bratt said, "Our traffic is not very much in the same segment of auto travelers."

Bratt said it is obvious from the survey that most auto travelers have little conception of what their trip cost. Only 80% even included gasoline among expenses, with little or no consideration of tolls, insurance, depreciation, fueling and food.

• **Travel** is considered a significant factor in the survey, and the survey sample is not representative enough, and the members of various participants in Mutual cooperation studies reached an early four-line limit to single-engine aircraft (AW Dec. 25 p. 24).

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Some carriers question the validity of the survey conclusions. One of the few participants in the survey, the airline at 1-1/2% potential diversion was too conservative. A spokesman for that carrier and there may be more potential diversion among the auto travelers who said they would still go by car even if auto costs were the same.

"We'd like to have a clearer idea of what, if any costs, would influence this very large contingent to switch to air travel," the spokesman said.

Bratt said it is apparent from the survey that the carriers must undertake more aggressive programs to promote air travel, since the largest percentage of auto travel is for pleasure. He added that the public would be more inclined to use the advantages of air travel.

Developing some means of persuading the traveler with an auto at destination is, in Bratt's opinion, one of the prime ways of attracting non-business. Present auto travel rates are not low enough to match that requirement, he said.

Bratt emphasized that carriers cannot claim that diversion of auto traffic is not something that can be accomplished overnight.

The participating carriers would not estimate what such diversion might cost, but all agreed that it would be substantial.

The study is valuable in the sense that participation of all major auto manufacturers and airline industry is good. Its conclusion that additional air travel cannot be created in easily, or as hard a haul, as the airlines would wish is, of course, not encouraging. But the problem should not be regarded as insoluble.

TWA and 8 still view the intensive travel traveling public as a tremendous potential in travel market. It will be a prime objective, as the airline's re-evaluated market expansion effort a TWA spokesman said.

Eastern was disturbed that the survey covered only travel distances of 400 mi. or more. Bratt and others on the survey committee felt that much longer distances should have been divided to reflect of under 200 mi. segments.

In other respects, the study concluded Eastern's belief that the air transport industry has had limited progress in solving its financial problems through its own ability to divert traffic from competitive forms of transportation, an Eastern spokesman said.

A Boeing spokesman said one of that company's primary interests in the survey was to probe the potential for a short-haul jet aircraft. Boeing was interested for the same reason.

# World Unrest Slows U.S. Air Policy Aim

By L. L. Doty

Washington—Impact of constantly changing political and economic conditions throughout the world on international air transportation is making it increasingly difficult for the U.S. to formulate a long-range policy for overseas airline operations.

The real need for a policy that will serve as a guide for the future growth and development of U.S. flag carriers is fully appreciated. Recently, however, a growing number of Administration officials have felt that such a policy cannot be fixed, but must be flexible enough to adjust quickly and smoothly to these international events and political transitions and, in some cases, upheavals.

As a result, there is declining support for the principle of protectionism which U.S. carriers want, and a strong leaning toward a flexible air transport policy, which in the eyes of some Administration officials, will permit the U.S. to be more adaptable to the changing world.

Then the debate over things won't stop, which has kept the U.S. preoccupied by better negotiations or capacity and route rights with at least five European airlines for several years, may soon resume. The most recent development at Civil Aeronautics Board Executive Air Carrier Panel (Trans World Airways July 2, p. 35), may prove to be an important factor in ending the debate.

At the same time, the continuing arguments over whether U.S. air transport should be conducted under the principle of the "closed" or "open" market, are still being fought out on a freely-competing multiple deregulation basis as it is now—beginning to take on a new importance.

Specifically, policy makers seek a pro-

gram that will enable U.S. carriers to maintain a strong competitive position in overseas operations without conflicting with the overall foreign policy of the U.S. There are signs that the White House steering committee, now directing the development of a new policy, is using the "security of the U.S." as one criteria.

The principle of protectionism has won greater favor in the short-term, particularly with the Administration, because it can easily be justified. President Kennedy's now-past political trade plan, on the other hand, is a clear-cut trend away from the right-biased principle toward the noninterventionist theory.

There are some of the factors, which will directly influence the makeup of the U.S. international air transport industry during the next few years that are complicating the formulation of a long-range policy:

• **European Economic Community.** The so-called common market is expected to create an transportation entity within Europe that reduces the number of airlines operating in and out of U.S. airports. In addition, if the common market continues to increase its influence, the standards of living and, in particular, per capita income, as expected, the European airline market will be as significant to the airlines as the U.S. market was, but now, U.S. carriers have already built an U.S. market at twice as their main traffic source and have diverted foreign flag carrier routes of this market, but they may now find themselves forced to leave European markets.

• **Airline Partnership.** President Kennedy's recent call for an alliance with Western Europe, and the recent announcement of a so-called regional partnership on a freely-competing multiple deregulation basis as it is now—beginning to take on a new importance.

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• **Probing and union agreements.** Hard economic facts of airline operations will continue to force the trend toward amalgamation, as has been done by the British Commonwealth nations, West European four-airline Air Union or the SAS consortium representing Denmark, Norway and Sweden.

The current switch in Spanish attitude toward civil aviation at hand a typical example of the changes taking place in Europe, but it demonstrates the need for a flexible U.S. policy. Spain now wants control in such key ports as Los Angeles, Madrid, Manila, Lyon and Johannesburg. It wants to expand its intra-European routes to reach all major European cities from Spain.

And the carrier with the most at risk of U.S. intervention is probably Air France. It will achieve its objectives on its own with the blessing of General de Gaulle and the full support of French government. De Gaulle's entire foreign policy was recently reviewed so that the country would operate under a highly professional and technologically efficient group.

However, airline officials in Spain recognize that they could easily revert to the former reference status if France were to do. In fact, as a result, a military pact would very possibly tilt over the government and before the announced theme to a stabilization level.

Meanwhile, Spain is planning its growth with an economic forecast that it has never before experienced. At part of this program, it asks, with government backing, an agreement with Pan American that could go so far as to

freeze pooling of aircraft and expand such an agreement world, of course, goes Pan American a foothold in Madrid, which has been considered as a good fit for TWA, the only U.S. carrier now entering the Spanish market.

During the recent negotiations between Iberia and Pan American, Spain never made a move to get Pan American entry into Madrid, presumably because Iberia did not want to face the competition of both TWA and Pan Am. In addition, Pan Am has not received U.S. authority to enter into the Iberia agreement and the recent CMR still stands as North Atlantic rights terminated that Pan Am be with down from Iberia as part of Spain (AVW May 14, p. 58).

So far, a mild form of protectionism has brought a halt to the expansion of foreign flag carriers within the U.S. Recently, the U.S. indicated its intent to ban KLM from flying to Los Angeles provided the carrier agreed to a strict limitation of capacity offered on the North Atlantic. The Dutch advised to accept the route on these terms but are not ready to end their flight for a West Coast route.

Altogether, Italian carriers, once agreed to provide traffic statistics to the U.S. as a first step toward capacity control, to exchange a route to Los Angeles. But later changed. Last month, the Italian again revised their stand and offered to exchange traffic statistics with the U.S. beginning three years from now if they were granted a Los Angeles route. The U.S. reportedly is not accepting these terms.

In its initial discussions, Spain proposed the airline U.S. carriers were negotiating with European airlines over capacity especially with the French and the Scandinavian. He noted, however, that with respect to European carriers the problem was not at a standstill as to justly a stiff regulatory rules of competition.

"It would be unreasonable to conclude that the latest difficulties with our foreign aviation partners involved in this stand demand a regulation control over foreign air routes of the magnitude implied in the proposed regulation," he added.

He also suggested that the proposed regulation, including foreign flag carriers to use the U.S. traffic and schedule restrictions—was justifiable to the whole international aviation industry." He said that it had already caused "considerable concern" within the entire industry.

But the statement of all others in his 85-page document, will no more to strike proponents of protectionism.

It is perhaps not surprising that the members of the liaison committee that had not considered in recommending the adoption of the proposed regula-



## Boeing Completes First 727 Nose Section

New section for the first Boeing 727 short-haul version cargo jet transport is shown as it is held from the fuselage at after completion at the company's Everett Division. First three-engine 727 is scheduled for rollout later this year.

tion the various factors bearing against the current United States effort for the liberalization of trade, such as the overall commercial situation between the United States and countries with which we have negotiated or trade with the balance of international partners and the costs involved to make international air transport to a country's given air space.

He also advised that the proposed regulation has a further dimension of the difficulties of ascertaining the issue of whether or not a proposed regulation permitting domestic and capacity limitations with respect to all foreign flag carriers is in the public interest.

The "closed" or "open" market principle is very much a live issue in the current thinking of policy makers, although it has remained dormant since 1948, when the entire U.S. airline industry, other than Pan American and United Air Lines, signed on with the government airfares of Nigeria, Ghana, East Africa, Central Africa and South Africa.

Little progress has been made in this regard, but the common carrier will long on U.S. routes, and the resulting influence on U.S. flag carrier operations. In recent testimony before a House subcommittee on appropriations, Edwin M. Martin, assistant secretary of state for economic affairs, and the State Department had not undertaken detailed studies of the common carrier as it will affect trade with the U.S. He added that "we have had some studies initiated by other agencies which have detailed statistics at their command, primarily the Commerce Depart-

ment and Sabena—all but as established fact, with France as a key factor. Ultimately, French approval is anticipated although President de Gaulle's decision will be based on his views toward the common market and the prospective power and cost savings of Air Union.

The 500-seat aircraft will be closely associated with Sabena. Currents of such countries as Poland, Czechoslovakia, Hungary, Bulgaria, Outer Mongolia and Red China operate in close association with Aeroflot.

Also Aeroflot has already signed a strong foothold. Eleven African nations, all former French colonies, have combined to form Air Afrique which, in turn and with Pan American, has close ties with the government airfares of Nigeria, Ghana, East Africa, Central Africa and South Africa.

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## New Supersonic Transport Studies

Washington—Federal Aviation Agency has well issued seven additional contracts totaling \$120,141 for research on supersonic transport studies (AVW June 21, p. 36). The following contracts being the list of supersonic transport study awards to 56 firms:

- General Electric's Flight Propulsion Division was awarded a \$745,000 contract and Pratt & Whitney Aircraft Division of United Aircraft a \$54,000 contract to conduct engine cycle studies. The program is to determine optimum operating cycle for supersonic transport engines at both ramjet and ramjet/supersonic conditions.
- Marconi Co. was granted a \$42,286 contract for work on aeroelastic flight controls.
- Sperry Gyroscope received a \$7,311 contract for flight instrument tests.
- Lockheed Aircraft awarded a \$16,070 contract and GE's Propulsion Division was awarded a \$14,991 contract to study engine and turbine factors.



Electronics testing equipment



Electronics engineering and manufacture



Ground support systems



Manufacturing technologies (MFT)



Space vehicle and system integration



Spacecraft control subsystems



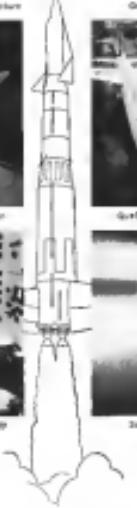
Complete weapon system management



Missile simulation technology



Space vehicle and system integration



## System-wide capabilities — at Boeing Aero-Space Division

A pioneer in weapon system management, Boeing has experience embracing all areas of system management and aerospace technology.

The Boeing Aero-Space Division includes more than 15,000 engineers, scientists, technicians, manufacturing and staff specialists. They provide the full span of technological and management capabilities required to handle the Division's present and future systems programs.

The Division's maximum research and development pro-

gram to assure continuing advances in scientific knowledge, as well as in business systems and management methods. On-time delivery is one of the many benefits of the Division's advanced programming and control technologies. Emphasis on quality control and reliability engineering has contributed toward the Division's outstanding record of performance in systems management. It has also assured the design and development of superior products, manufactured and delivered on schedule, at lowest cost.

**BOEING**  
AERO SPACE DIVISION

# Carriers Defend Non-Flying Businesses

By Ward Wright

Washington—Subsidized carriers are greatly concerned that a Civil Aeronautics Board proposal to encourage non-air transport activities will lead to revenue management and do away with one means of reducing subsidy.

CAB started the rulemaking to see whether "use significant non-transport activity" be a subsidized air carrier right.

- Create financial aids which could undermine its effective operations.
- Direct the manager of management from the carrier's transportation activities.
- Create problems "with regard to the allocation of expenses as between the air transportation and other activities of the carrier."

### Carriers on Course

Under the proposed rules, CAB would consider all non-transport activities of subsidized carriers prior to any in the public interest when acting on carrier transportation. The carriers would have to prove otherwise.

Industry says the rules could have a profound effect on the character of the subsidized carriers, depending on how the Board chose to use it.

Most subsidized carriers feel it is typical for a carrier to have a main route involving two or more routes. These routes are related to air transportation activities and not all other factors being equal, 20% of the avoid routes thus could prove that activities were in the public interest.

In that way, some carriers feel CAB could coerce the industry into giving up all of its non-transport activities.

Right now, such a policy would affect only one Division and at least three Alaska carriers.

All have routes other than strictly air transportation.

Proponents of the expanding non-transport activities of subsidized carriers consider CAB carriers are:

- Allegiant Airlines, recently organized car rental division Allegiant's current car rental facilities are now available at 13 of 18 points on its route system. It will Allegiant hopes to add to its 10 more car rental branches along its routes. The airline views car rentals as a natural extension to its airline operations.
- Alaska Airlines' food-based operations, embracing maintenance, flight support and dispatch for other carriers and gen-

eral aviation and aerospace overhaul for military contract. Non-transport activities earned about \$370,000 for Alaska in 1961.

- Braniff Air Lines' maintenance repair and communications equipment repair and services at Phoenix. Braniff also performs wartime checks on U.S. Army's Fairchild C-127 at its Las Vegas shop.
- Matson Air Lines' use of its ships for general marine maintenance and overhauls, mostly which brought in \$585,000 for the last quarter of 1961.

- Northern Consolidated and Wien Alaska airbus chain of social sports clubs and hotels in Alaska. Wien also operates restaurants and bars located in connection with its hotels. Wien's non-transport activities net about \$500,000 yearly.
- Pacific Northwest, which operates Piedmont Airlines as a division and is the largest operator of general aviation shops in the local service industry. It carries performs maintenance and overhauls on Lockheed Lodestar and smaller aircraft in its general aviation division and services P-21, P-66, 1 and other smaller aircraft as well as its flight school.

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Several small and local carriers feel that the rules could have a profound effect on the character of the subsidized carriers, depending on how the Board chose to use it.

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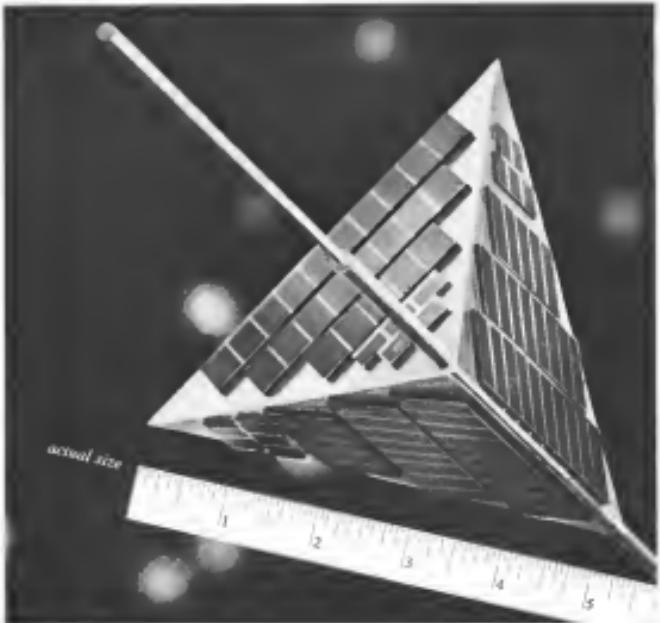
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The world's smallest satellite has been developed by Space Technology Laboratories. Its design will be different from all other satellites before it. STL engineers and scientists have used a re-entrant configuration to bring about some remarkable characteristics in a space vehicle. There will be no need for batteries nor replacement in flight. The satellite will have no hot rods, no cold rods. It will require no attitude control about. No matter how it tumbles in space, it will always turn one side toward the sun to absorb energy, and then set it away from the sun to cool instrumentation and telemetry equipment module. It can perform medical experiments in conjunction with other projects. Or it can be put into orbit by a small rocket to make studies of its own, as in five or more separate experiments on each mission it makes.



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## SHORTLINES

► American Airlines' new embossed simplified green-blue eagle design within an ellipse bordered by an orange circle—still Sigma appearing on ground equipment at Bilevel Airport has much and will continue to become standard throughout the airline.

► California Automobile Corp., of North Hollywood, has taken over controlling interest in Associated Air Transport of Miami. The company, which also owns Lockheed 747 and 1044C Constellations on passenger charter flights to Puerto Rico-Mexico-Chicago and Barbara-Barbados-Hawaii routes. Its secreted headquarters is being moved to Burbank.

► Capital Airways, a U.S. supplemental carrier, has purchased five Argosy 650 transports from Freighters from Worldwide Courier Airline Ltd. (IAW Mu 28 p 41) and is operating them as U.S. Air Force L-101As. Another company, Capital, is also negotiating for the purchase of two additional Argosy for possible use in commercial service. Terms of the sale were not disclosed.

► Federal Bureau of Investigation and recently it has investigated 1,565 false reports of birds aboard commercial aircraft since survey of the airways last year. FBI said it identified 460 imports and presented 47, of which 45 were convicted and 17 were to jail for terms of six months to a year.

► Los Angeles Airways' Mai traffic fig. and show a 58% increase in passenger traffic over May, 1961. Los Angeles credits the increase in passenger as a result of its 25-seat Sikorsky S-41 helicopters put into service last March.

► Military Air Transport Service has awarded \$33 million in contracts to 16 airframe manufacturers for aircraft to be used for passenger and cargo services during Fiscal 1967. Of the total, \$30.1 million was awarded for U.S. Air Force L-101As, and \$3.4 million for C-130 Hercules. Contracts were let to: Pacific Airlines, 37.8 ANTONOV Airlines, 5.3 Capital Air Transport, 51.1 Zambian Air Transport, 56.4 World Airways, 55.4 and Alaska Airlines, 51.4.

► United Air Lines says it flew 58,465 passengers on June 29, which is claimed as the first time in commercial aviation history that a carrier has topped 50,000. United and 6,711 passengers boarded at Chicago's O'Hare Airport for a single-day record for that city.

## AIRLINE OBSERVER

► Configuration of three Aero 745 series 2 freighters transports by ROMC for its subsidiary, Adam Aircraft, was made because the aircraft did not meet American aircraft design standards of the time. The aircraft, which is a twin-engine, twin-seat, all-metal monoplane, is built in Brazil. Adam Aircraft, which is a made public, is that INGAC, the company it is taking a hard look at its future, since the 745s would have cost about \$1.5 million. Orders for the 745 now stand at 20 for civil operation and between 30 to 40 for the Brasil Air Force.

► Positive control of terminal area traffic, a major recommendation of the Project Reserve report on ATC, will begin Nov. 15 in Atlanta on a trial basis. Begun by Aviation Week (IAW Mu 16 p. 50), this initial step toward reorganizing controlled terminal traffic at a major airport will be based on expanded use of radar and involve the airspace extending down to 6,000 ft. Pilots of VFR aircraft entering the area are to report their positions over prescribed checkpoints in synchronizing with IFR traffic.

► Schaefer's rugged Av-2 biplane shows little indication of fading from the Russian air transportation scene despite Soviet measures done more than a year ago that would soon be replicated in modern-day civil craft. This new Av-2, recently originating at Irkutsk, a large provincial capital south west of Moscow, has been designated for service as the 12-place Av-2.

► Trans World Airlines is reorganizing its sales organization through the creation of a new marketing division, which will replace the sales division and combine all sales activities from the general sales office to the district level, and incorporate all scheduling and market-research activities. Thomas B. McMillan, former National Bookkeeping Co. vice president, has been elected vice president marketing to head the new division. Title of vice president and general sales manager, held by L. P. Marcelli, has been discontinued. Marcelli will continue as a vice president of TWA.

► United is extending civil air routes throughout Africa. Bilateral air transport agreements have been signed with seven of the 11 nations comprising Air Africa: Senegal, Mauritania, Gambia, Niger, Central African Republic and Republic of Congo. Meanwhile, Aeroflot has negotiated a new route from Moscow to Basilia via Kishin and Constanza (IAW June 25, p. 36).

► Chicago's Midway Airport, for years the world's busiest airport, last week lost its last scheduled airline flight. United Air Lines transferred its remaining flight to O'Hare International Airport, leaving only private aircraft flying at Midway, which, on its busiest day in 1959, handled a total of landing and takeoff 51,900.

► Proposed reorganization of the Air Transport Assn. is now under study in its airline members. The plan, which calls for elimination of all conferences except the Air Traffic Conference, was presented to the board of directors at its last meeting, but it was felt then that all ATA members should have an opportunity to comment on it. A final regular board meeting is scheduled for December, but it is expected that a special meeting will be held in October after all airline comments have been received. In view of the proposed reorganization, purpose of the plan is to permit the ATA staff to act in a marketing function other than serve the industry, simply in a sense that it has in the past. Meanwhile, the directors are expected to approve a substantially advertising budget for ATA.

► U.S. airline traffic showed a 12.3% improvement during the first six months of 1962, compared with the same period last year. Coach traffic accounted for 62.9% of all traffic during the first half of the year, compared with 51% in the corresponding period last year. Traffic increase showed in June, when it rose 6.9% following regular monthly gains of about 11% since the first of the year. June load factor of 58.7%, although 2% below that of June, 1961, is the highest registered to far this year. Flight capacity strike against Eastern Air Lines had a definite effect on average passenger load growth in June. Two of Eastern's chief competitors, National and Delta, were principal beneficiaries of the strike, with traffic gains of 14% and 16% respectively in June. Third competitor, Northwest, showed a decline in revenue passenger miles for June.



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## Airline Traffic—April, 1962

	Revenue Passenger Miles (2000)	Revenue Passenger Tons-Miles	Passenger Load Factor %	U.S. Mail Tons-Miles	Freight Tons-Miles	Total Tons-Miles	Overall Load Factor	
<b>DOMESTIC TRUNKS</b>								
American	887,986	328,088	77.9	2,791,231	12,289,129	66,479,829	82.0	
Southwest	90,180	35,200	81.0	481,250	172,100	65,432,250	82.0	
Continental	72,711	26,600	76.6	1,179,120	8,850,200	30,250,320	76.2	
Delta	347,418	223,543	81.0	799,721	353,721	2,117,463	84,681,647	81.0
Eastern	812,548	485,328	82.8	1,644,117	671,038	3,280,516	47,975,847	82.0
Northwest	126,388	126,388	81.7	434,140	78,076	1,438,420	47,177,710	81.3
Northwest	154,295	46,024	89.7	160,065	56,276	209,489	8,156,927	81.2
Trans World	121,121	41,121	81.0	210,100	20,100	330,300	80,305,200	81.0
Trans World	481,204	334,524	81.6	1,671,244	733,979	4,687,171	41,185,515	82.0
United	1,230,872	654,481	84.2	4,991,414	1,314,313	10,558,437	24,616,338	85.9
Western	133,454	88,998	85.9	314,225	423,174	9,385,388	42.9	
<b>INTERCONTINENTAL</b>								
American	31,227	12,331	89.8	7,789	416	318,481	1,952,763	71.4
Delta	8,098	16,501	81.7	59,789	303,884	25,277	1,265,913	81.2
Continental	44,421	3,797	81.0	1,179,120	8,850,200	30,250,320	76.2	
Delta	10,149	573	86.0	440	—	10,137	111,240	84.6
Eastern	33,794	61,159	80.5	140,355	3,429	287,975	4,284,216	84.9
United	11,143	1,836	86.7	—	234	7,287	103,810	85.8
Northwest	21,011	41,356	85.8	1,893,868	3,898	161,359	7,766,817	85.5
Pan American	—	—	—	—	—	—	—	—
Airline	4,185	3,996	87.3	91,291	3,333	1,250,486	859,268	89.5
Airline	189,131	16,521	86.0	2,029,200	7,200	2,029,200	22,800,000	87.0
Lana American	187,450	346,116	86.7	482,214	8,224	4,388,180	18,320,000	87.1
Panair	41,468	172,892	83.6	3,646,209	17,389	4,761,314	24,465,818	83.8
Panair	10,374	19,048	82.2	161,186	—	1,023,210	2,815,317	81.2
South Pacific	137	419	86.1	1,473	—	181	36,923	86.2
Tam Caribbean	13,109	20,348	88.4	—	—	3,130	32,000,000	88.4
Trans World	25,124	18,408	87.4	3,180,100	12,863	3,240,446	12,465,301	89.1
United	12,273	3,429	86.4	363,275	12,863	4,419,486	12,465,301	89.1
Western	8,999	12,448	89.4	32,718	—	50,621	1,343,714	77.0
<b>LOCAL SERVICE</b>								
Allied	31,703	17,820	84.8	32,703	38,224	89,561	1,830,616	47.3
Braniff	33,382	8,661	87.8	6,921	2,903	14,767	83,815	95.6
Continental	29,120	8,661	81.0	10,000	11,200	30,720	833,977	97.4
Frontier	7,723	2,201	82.0	2,201	11,113	40,184	1,200,000	82.0
Lake Central	2,266	5,959	81.0	1,749	25,474	25,474	82,817	81.0
Midwest	85,831	17,439	88.8	24,020	20,598	47,228	1,281,200	87.3
North Central	83,686	14,758	86.3	41,502	46,410	70,193	1,362,743	82.0
South Central	37,424	18,348	87.7	29,685	28,356	36,333	1,377,381	85.8
Pacific	40,387	8,499	83.2	54,219	4,459	10,736	916,861	53.7
Pacific	26,279	14,444	84.4	18,737	18,373	29,474	1,248,542	85.7
Southwest	39,339	3,733	86.3	20,885	15,248	40,963	814,313	86.3
Trans World	31,826	7,728	81.5	14,304	5,189	23,487	782,401	81.9
West Coast	—	—	—	—	—	—	—	—
<b>HAWAIIAN LINES</b>								
Airline	32,002	6,682	84.5	3,838	—	4,373	304,607	57.4
Hawaiian	81,129	5,963	87.7	3,618	—	110,942	644,547	57.7
<b>CARGO LINES</b>								
American	—	—	—	—	—	—	—	—
Flying Tiger	2,148	8,316	81.4	11,950	35,744	20,316	22,550,000	88.2
Riddle	—	—	—	2,437	5,341	5,377	1,371,433	43.3
Continental	6,318	31,248	86.9	11,223	7,336	1,318,371	4,745,765	86.0
Seaboard	781	4,844	85.7	—	—	3,794,767	4,334,767	67.4
Hawaiian	—	—	—	—	—	8,306,274	8,385,894	88.6
<b>HELICOPTER LINES</b>								
Change Helicopter	9,348	138	84.4	1,051	8,158	—	38,793	84.4
Los Angeles Airways	5,026	168	81.7	4,339	2,757	—	22,677	81.7
New York Airways	13,713	248	81.8	456	912	559	25,616	82.4
<b>ALASKA LINES</b>								
Alaska Airlines	6,578	3,438	88.6	46,786	3,454	316,987	1,133,164	53.5
Alaska Central	6,831	576	83.1	8,283	8,481	74,193	65,183	53.3
Continental	3,300	315	84.8	9,210	—	36,939	81,131	66.0
Frontier	4,432	34	83.8	6,577	—	6,577	4,959	59.0
Midwest	2,207	673	84.4	2,207	—	2,207	1,200,000	84.4
Pacific Northern	7,953	4,244	84.8	148,329	10,023	487,319	1,388,044	53.3
Pacific Southern	1,362	1,268	86.8	67,584	—	34,571	29,393	64.4
West Alaska	7,638	1,819	84.3	12,587	—	14,827	318,129	50.3
Alaska	7,416	479	85.1	—	345	479	41,184	50.3
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board. U.S. includes excess baggage.								

## Airline Income and Expenses—April, 1962

	Passenger Revenue Miles (2000)	U.S. Mail	Freight	Charter	Total Revenue Miles	Total Operating Expenses	Total Non-Operating Expenses	Non-Operating Expenses Per Miles
<b>DOMESTIC TRUNKS</b>								
American	34,146,779	85,416	428,649	7,210,338	34,146,779	16,721,441	26,721,338	1,541,124
Southwest	12,208,649	221,712	52,547	2,112,917	12,208,649	11,211,023	11,211,023	952,000
Continental	4,386,080	34,000	34,000	3,213,000	4,386,080	3,213,000	3,213,000	744,000
Delta	14,534,080	300,000	145,800	367,800	14,534,080	13,793,000	13,793,000	924,000
Eastern	12,079,200	217,812	217,812	2,912,747	12,079,200	11,541,000	11,541,000	749,000
Midwest	4,271,243	41,378	28,940	3,213,243	4,271,243	4,331,987	4,331,987	1,011,243
Northwest	7,169,453	125,392	—	1,309,393	7,169,453	6,053,547	7,537,453	148,724
Trans World	21,021,643	549,200	—	2,021,643	21,021,643	20,211,671	20,211,671	1,005,000
United	31,344,000	4,200,000	—	4,200,000	31,344,000	24,500,000	24,500,000	774,000
Western	5,241,285	113,318	—	2,000,000	5,241,285	3,200,000	3,200,000	643,321
<b>INTERNATIONAL</b>								
American	210,348	8,210	1,434	44,446	210,348	105,337	122,337	153,183
Southwest	649,749	35,311	77,543	5,233,000	649,749	49,540,000	19,540,000	159,734
Continental	20,394	3,000	3,000	2,020,000	20,394	1,940,000	1,940,000	1,000,000
Eastern	2,887,121	8,456	18,828	6,349	2,887,121	2,747,000	2,747,000	81,000
Midwest	185,181	—	260	4,871	185,181	173,367	173,367	8,749,721
Pan American	28,000,000	3,000,000	4,000,000	1,237,000,000	28,000,000	23,000,000	23,000,000	1,000,000
Airline	28,000	—	—	4,487,000	28,000	2,000,000	2,000,000	87,000
Alaska	1,219,000	1,346,000	—	3,245,000	1,219,000	1,217,000	1,217,000	2,000,000
Antarctic	7,000	—	—	1,000,000	7,000	1,000,000	1,000,000	1,000,000
Caribbean	7,000	—	—	1,000,000	7,000	1,000,000	1,000,000	1,000,000
Europe	67,000	—	—	1,000,000	67,000	66,000	66,000	1,000,000
Latin America	60,000	—	—	1,000,000	60,000	59,000	59,000	1,000,000
Passenger	1,200,000	—	—	1,000,000	1,200,000	1,190,000	1,190,000	1,000,000
South Pacific	1,200,000	—	—	1,000,000	1,200,000	1,190,000	1,190,000	1,000,000
Trans Pacific	1,200,000	—	—	1,000,000	1,200,000	1,190,000	1,190,000	1,000,000
United	1,200,000	—	—	1,000,000	1,200,000	1,190,000	1,190,000	1,000,000
Western	1,200,000	—	—	1,000,000	1,200,000	1,190,000	1,190,000	1,000,000
<b>HAWAIIAN LINES</b>								
Airline	422,327	2,619	—	4,878	422,327	444,156	435,278	14,369,723
Hawaiian	934,737	4,636	—	—	934,737	719	933,111	944,736
<b>CARGO LINES</b>								
Flying Tiger	—	—	—	—	—	3,412,213	3,412,213	3,471,978
Seaboard	—	—	—	—	—	3,412,213	3,412,213	3,471,978
Seaboard West	—	—	—	—	—	3,412,213	3,412,213	3,471,978
Star	—	—	—	—	—	3,412,213	3,412,213	3,471,978
<b>HELIICOPTER LINES</b>								
New Mexico	55,198	66,400	3,476	129,366	55,198	129,366	129,366	121,721
New York Airways	21,003	13,113	14,737	17,755	21,003	14,737	14,737	33,792
Alaska Airlines	161,320	1,700	2,354	2,487	161,320	3,000,000	3,000,000	22,834
<b>ALASKA LINES</b>								
Alaska Airlines	265,000	29,356	442	58,482	265,000	842,218	192,748	187,748
Alaska Central	17,754	11,440	—	11,636	17,754	12,710	12,710	7,162
Continental	1,284	981	—	1,285	1,284	18,154	18,154	18,152
Northwest Consolidated	67,261	9,649	—	9,717	67,261	24,000	24,000	24,000
Pacific Northern	44,723	5,700	—	5,700	44,723	15,209	15,209	15,209
West Alaska	117,735	48,188	—	48,188	117,735	28,553	28,553	28,553
Western Alaska	6,427	5,503	—	5,503	6,427	8,426	8,426	8,426
West Alaska	70,693	81,323	—	36,817	70,69			



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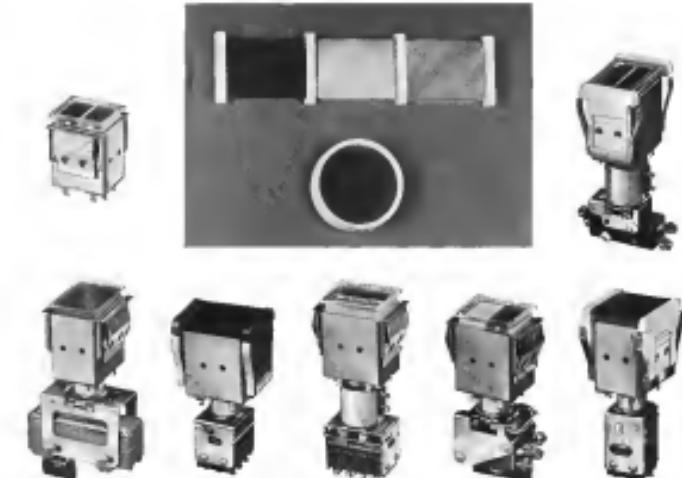


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## Radar, Infrared Studied for Rendezvous

By Barry Miller

**Los Angeles**—Glowing number of aerospace companies are investigating and/or developing sensor, particularly radar and infrared/optical techniques for use by space vehicles as rendezvous and return using high with Earth and also vehicles in space.

These efforts partially are an outgrowth of government funded rendezvous sensor studies and the need for flight hardware for both civilian and military applications. With the National Aeronautics and Space Administration's decision to use its house-rendezvous techniques to speed the Apollo lunar landing, substantial new sensor radar development may be expected from industry.

Westinghouse currently is developing a rendezvous radar system (AW, Apr. 23, p. 26) to be delivered to NASA next year for use in the Gemini program.

In addition, the need for missile-like, high-performance sensor/guidance system for military vehicles in programs like the Satellite Intercept, or Sunt (SINA) program, and possible as mission and mission follow-ons, probably will stimulate further interest in

the field. In USAF Space Systems Division's recent short-term mission Study program (AW, June 4, p. 34; June 25, p. 25) two studies, for which Hughes Aircraft and Rutledge were picked as potential contractors, were to have been devoted exclusively to sensor/guidance.

Even without formal Air Force backing, a number of traditional aerospace manufacturers are running rendezvous sensor efforts, some in conjunction with un-funded space studies conducted by major spaceplane manufacturers. For example, last year work was begun with Martin-Marietta and Boeing, assisting the latter with its Project STARDAM anti-collision weapon sensor studies (AW, June 15, p. 26).

Senate task force may be required to re-invoke measures to match the Senate's Senate Appropriations Committee to conduct studies of a target vehicle that might be developed within five years to aid USAF's Interceptor missiles proposed after satellites are held this spring by Space Systems Division (AW, Apr. 23, p. 99). Eighteen proposals reflecting many companies active in rendezvous sensor development were submitted. The 18 are being held to include Westinghouse and Electronique which supply the long and close range radar index for USAF's current 677A interceptor, Rutledge Space Reed, Hughes Aircraft, Space Technology La-

boratories, Airborne Instruments Laboratory, General Electric, Grumman, Jewell Associates, Klein Corp. of America and General Dynamics Aerospace. Funds intended for this program were realigned elsewhere and program objectives are now being revised to allow it to continue with minor items another project.

• **Radar-based sensor.** Proposals for a 14-month research and development effort covering the general of infrared, RF and optical techniques were requested by Aerospace Systems Division this spring (AW, Apr. 23, p. 99). Requests were received in record numbers. In-draft proposals are now due late this month.

The nature and magnitude of difficulties associated with sensor requirements for rendezvous vary markedly depending on whether the rendezvous is cooperative, in which case the chase and target vehicles probably try to effect rendezvous, or non-cooperative. In the latter case, the target vehicle may not only not aid in rendezvous, but may at attempt to evade rendezvous and pass or crash chase vehicle sensors. If two or both vehicles are missed, the complexity of the sensor problem changes again.

Reliability and high performance, including long-term stability and clear sensor range through the range of intended operation, are expected to be top considerations in selecting electronic sensor means for rendezvous systems. Functional requirements demand for small size, light weight and low-power requirements also will be important, but not necessarily primary objectives, at least in the integrated, large size missile military space vehicles.

• **Cooperative sensor.** Proposals for a 14-month research and development effort covering the general of infrared, RF and optical techniques were requested by Aerospace Systems Division this spring (AW, Apr. 23, p. 99). Requests were received in record numbers. In-draft proposals are now due late this month.

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### riendly Rendezvous

If rendezvous is friendly, radio-frequency beacons or transponders can be carried on target vehicles, thereby lowering RF power requirements. While this is an excellent method of rendezvous, the equipment on the chase vehicle, or tracking system performance or a cost because of those. A target vehicle also can remain passive, but less cooperative than being fitted with a cluster of corner reflectors. Search, detection and identification and tracking techniques may all be more simple in the cooperative than in the non-cooperative case.

Typical types of tracking data required for guidance and control is a cooperative system that may be sensed directly or derived from sensed data, as indicated in Hughes Aircraft rendezvous studies, include:

• Range data from a maximum of 100 mi to closure range with 17% detection range, 2.5 mi, reliable and close range (possibly possible in the docking phase). Military requirements may require tighter accuracies.

• Range rate from a maximum of 400

### Sensor Combinations Requiring Development For Cooperative Rendezvous

Combination	Terminal Angle Range	Docking Angle Range	Est. Availability
Pulsed radar	X	X	
IR angle tracker (auto.)	X		X
Stroboscopic range (auto.)			1962-1963
Range only radar	X	X	X
IR angle tracker (auto.)			1962-1963
Stroboscopic range (auto.)			
IR angle tracker (auto.)	X	X	X
Optical intensity ranging (auto.)			1963-1965
IR angle tracker (auto.)	X	X	X
Optical intensity ranging (auto.)			1964-1966
Required sensor: radar, tracker (auto.); IR angle & optical radar for range	X	X	X
Stroboscopic range (auto.)			1963-1968

### Sensors Available For Cooperative Rendezvous

Combination	Terminal Angle Range	Docking Angle Range
Pulsed radar	X	X
Visible motion techniques		X
Pulsed radar	X	X
IR angle tracker—automatic		X
Stroboscopic range—manual		X
Range only radar	X	X
IR angle tracker—automatic		X
Visible—manual		X
Range only radar	X	X
IR angle tracker—automatic		X
Stroboscopic range—manual		X
Pulsed radar	X	X
Visible—manual		X
Range only radar	X	X
IR angle tracker—automatic		X
Television—manual		X

**SENSOR COMBINATIONS** indicated in top may become available at time indicated. In underlined entries where target vehicle has broken. Bottom chart shows no sensor combinations available for cooperative rendezvous with sensor-equipped vehicle.

For effective rendezvous, a set of sensors, not simply radar alone, probably will be required. In non-cooperative situations (bearing the need to impact and possibly destroy) when space vehicles, to close space deficit and to rendezvous with a friendly vehicle that



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is unable to add in rendezvous, the miss as well as sensor inaccuracy becomes especially important. When the flight uses velocity as a performance measurement against the chase vehicle, deployment of techniques may be essential. The chase vehicle may then need passive techniques to sense nuclear or RF calibration from the non-cooperative target.

In reviewing sensor requirements for cooperative rendezvous, Hughes prefers using offset types of RF sensors, or, during non-cooperative rendezvous, pulsed radar with a transponder for velocity guidance to obtain range, range rate, angles and angle rate down to the final 100 ft from docking (a preference not shared unanimously among various companies studying rendezvous). The radar might be supplemented by an optical device for the last 100 ft.

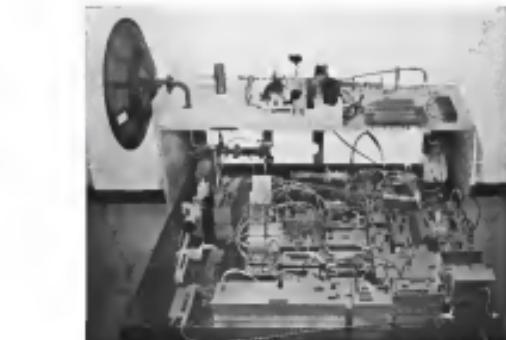
FM/CW radars, Hughes points out, are naturally limited in maximum range due to the noise and the conversion requirements of a questionable value at short range during closure, although less so than a pulsed radar system. In general, Hughes regards RF sensor as being suitable for attitude guidance, but limited in maximum range performance and unsatisfactory for docking.

Infrared optical sensors, Hughes engineers point out, are well adapted to angle tracking at ranges where suitable signal levels are available. A cooperative infrared source steered in attitude can be employed effectively at rendezvous ranges. Angle and angle rate are available at higher accuracies and with higher repetition rates than necessary for 100 ft range. In addition to a cooperative infrared source, a beam splitter can be used on the target for more accurate tracking. Infrared velocity can be stepped down in the range direction thereby keeping a useful source intensity even at docking ranges.

The practical shortcoming of an optical sensor, difficulty in obtaining range data, has several solutions. A calibrated source on the target vehicle and a separately calibrated receiver on the chase can provide intensity ranging to useful accuracies. Hughes says, in these rate measurements would provide range rate.

Doppler radar techniques (AW Feb 27, 1961, p. 61) under intensive development at Hughes and elsewhere can provide the needed range and high reflected signals and range rate measurements at longer ranges and perhaps with resolution superior to that of RF systems. With passive infrared angle tracking, enhanced optical radar offers an essential possibility of reducing a single integrated optical system. Such a rendezvous sensor system, Hughes estimates, might be available between 1967 and 1968.

For docking, natural visible devices and transverse optical devices could



CLOSE-UP OF STL RADAR/TRANSONDERS: underneath certain show radio components which STL units can be packaged into system weighing 40 lb., net including antenna

### After stereoscopic cooperative capability

Both optical and RF techniques and combinations of them are under study for non-cooperative rendezvous. An RF approach to this would involve using coherent pulse systems from a maximum range of 50 ft down to 100 ft, and FM/CW radars from that point according to Hughes. A system of that type could be operational in 1964. As an optical approach to non-cooperative rendezvous, Hughes suggests a combined solid-optical/liquid-optical radar system in which IR will handle target separation and angle tracking and the optical radar would supply range data. At ranges shorter than 50 ft, an FM/CW radar would again be necessary.

### Optical Detection

Because of large possible power savings, passive optical detection is often suggested for the search and separation of close targets to save the power that otherwise would be necessary in retrieving large volumes of space.

Passive devices could sense energy emitted by a selected source among a coplano target. Sources of this type are solar solar radiation reflected from the target, thermal emission from the skin of the vehicle and perhaps radiation from vehicle rocket in the event hot gas attitude control and maneuvering rockets are employed for evasive maneuvers.

Under certain conditions, reflected solar radiation can offer an advantageous technique for detecting when sufficient energy is available to make a sensor that is passive and reliable than a pulsed microwave transponder because it can make possible all passive components.

The use of detectors, like image intensifiers and photomultipliers, which are more sensitive at shorter wavelengths (visible and ultraviolet) than infrared. Thermal radiation is a more reliable source of radiation for sensing because the target vehicle may be sensible at certain wave lengths, or may be invisible if its surface has low reflectivity. In addition, Hughes points out, the detector sensor system would be blind to low-level, potentially dangerous foreign artifacts which would vary in the earth's shadow during much of the time.

### Reader Studies

Radiation in Missile and Space Division has been studying radar without line-of-sight rendezvous for the last time as part of its studies on Manned Space Flight Center's Orbital Research Operations (AW Mar. 15, p. 78).

For the cooperative rendezvous case, it suggests a sensitive microwave FM/CW radar transponder which, it says, would provide sensitive velocity and range data even at close range and low velocity. At X-band, an accuracy of 0.05 ft/sec. is possible by employing Doppler cycles for a second. Range can be measured in a fraction of the time with a ranging technique of summing phase of two or three modulating frequencies in a few microsecond.

The transponder designed around a single microwave noise source and local oscillator can offer an advantage in weight. In addition, it is easier to build than a transponder of the case, which is more reliable than a pulsed microwave transponder because it can make possible all passive components.

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## Bendix Radio Division



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*H.C.*



United States Patent No. 2,921,122. Identifies under HAD Specification 1440 and meets American Pages HAD 132B and 1391. For further data see the Cherrylock 2850 Series Sheet, with Fessenden Company, Cherry Rue, Glendale, Box 21104, Santa Ana, California.

Cherry Rivet Division  
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and solid-state circuits working at low peak power levels, the company ce plans.

Burthaus proposes a K-band radar (13.2 to 15.25 GHz) with a antenna configuration such that it does not look through any panels, reflect from what would tend to produce high electron densities through ionization and cause waveguide shorts, and not range-rate errors, particularly at lower frequencies. To meet the same needs, if K-band at 14.0 GHz (400 ns), electron density would have to be three orders of magnitude higher. Electron densities due to metal layer ionization will sum in orders of magnitude over the front portions of the domes, making radar performance dependent on radar range, reflecting light to the front, back and side panels.

The proposed K-band system, shown in accompanying block diagram, would use 1.5 watt 33.4 kHz microwave oscillator, provide a stabilized oscillator for a cavity filter shunt driven by modulating frequencies of 2.1 mc, 48 Lc and 400 cps, corresponding respectively to microwave ranges of about 8.04 cm, 1 cm and 100 cm. Minimum required phase shift between wave in a single 1/2 radian, giving a modulation index of 1 at each modulation frequency.

Frequencies-modulated microwave received at the antenna of the transponder on the target vehicle will be mixed with the output of a local oscillator, stabilized sufficiently to ensure that the resulting source frequency is matched to a selected harmonic of the target. The local oscillator is a 100 MHz quartz-controlled, multiplied up to 24 mc, mixed with the 10 mc signal from one (or two) Doppler shifted carrier and sidebands to produce a 24 mc signal. This signal is then mixed with the local oscillator output resulting in a carrier frequency 24 mc (not ensuring the Doppler shift) higher than the frequency received by the transponder.

The additional 24 mc represents a signal received from the radar transponder (since it was derived from one oscillator) or it is conceivable to make transponder and receiver share a 120 mc source through a 120 mc local oscillator, thus having a 120 mc signal at each end of the transponder.

Signals returned to the radar by the transponder are mixed with CW wave after cavity energy, producing a 26.4 MHz.

The microwave Doppler signal is up-converted 20 db, so for good signal to noise ratio for accurate data processing, the pre-detector bandwidth is held below 1.6 K. A frequency translator acts as filter.

The translator with a variable frequency multiplier and fixed multiple impulse ratios reads the subbands to obtain good signal to noise ratio. The output

of the mixer filter is heterodyned with the 24 mc reference frequency to produce a Doppler frequency measured by counting ticks over a given period for velocity to an accuracy of about 0.05 ft/sec for a one-second averaging time.

Modulation sidebands plus carrier are mixed to the downconverter, using frequency sidebands are removed and phase compared with original modulation frequencies.

### System Reliability

To increase system reliability for a communications system in which the message to be sent to the transponder can have the shortest lifetime among system components, Burthaus recommends two coherent reference pulse Doppler and FM CW sides of the same frequency, total antenna aperture and receiver noise figure to determine whether the transponder could be eliminated. In this case, it again selected FM/CW due to an apparent system benefit because of the paucity of low reliability parts, gain, noise figure and range rate capabilities and stability due to power and aging factors.

Removal of the transponder requires a substantial increase in message bandwidth to make 10 mc available over a range of about 10 cm. System sensitivity is most effectively improved with a narrow selective cluster on the target frequency comprising a volume of a 2 ft cube (volume filter) 40 db above center frequency thus boosting sensitivity by 16 dB.

This may also solve problems of ghost effect at short range.

Other methods of improving system sensitivity, a number of which will be explored, include a small aperture in transmitter power or the use of a low noise parametric amplifier to lower receiver noise figure, and the use of a multiple filter acquisition scheme to reduce inter-pulse power requirements.

An short range communications system will be most efficient because of low signal to noise ratio. Consequently, Burthaus recommends a transponder over the corner reflector, suggesting the possibility of using a configuration with the reflector as a ledge if the radar can work with or without a corner reflector.

The radar corner reflector is generated by a 44 mc crystal controlled oscillator, then multiplied to 168 mc, where it is transmitter power multiplied 30 times

passing through a series of parametric amplifiers, biased varactor diodes which serve as harmonic generators. In this fashion the corner signal is multiplied up to 8 GHz.

Peak 32 power output is 80 milliwatts (beam power is available at 100 per cent of the midpoint of the figure that is, peaked at 1 watt) at X-band, 3.5 watts at S-band, assuming continuous use of solid-state components throughout. Addition of parametric amplifiers could halve the 168 mc receiver noise figure.

An X-band beam splitter consisting of two ferrite resonators configured, the

combination transmitter or corner reflector weighs 34 lb, requires 150 watts, generates 5 watts, has a MTBF of 2,000 hr and requires 4600 hr noise figure of 7.5 dB.

For the non-cooperative situation, Burthaus calculates that a 13 dB increase in performance will be necessary for the radar designed with dual transponder-corner reflector capability. This assumes the target has an echoing area of 2 sq meters.

The increased performance may be obtained by substituting a parameter amplifier for the transmitter for 45 dB improvement in receiver sensitivity, an amplifier in place of the 5 Watt MTBF for a sufficient measure to take effect to increase transmitter power by 84 dB.

If the problem is followed by an application, arriving at Burthaus, both can be used for a short time during acquisition and early tracking phases. As referencing velocity approach one another, the amplitude reply can be switched off and radar operated at low power during target locking or during target loss-of-grip phase. This could save power and simplify tracking and reducing the range search problem the computer into.

### Equipment Available

Among specific rendezvous radar equipment now available in development or being proposed, are the following:

• Space Technology Laboratories—An X-band all solid-state radar transponder system developed by the feasibility demonstration stage, recently marketed over a 47,000 ft range between Belmont Beach and Palos Verdes, Calif., by Space Technology Laboratories. The radar measurement range with a 126 ft beam, at range 10 times wider at night, is 1000 ft. The system has a 1000 ft range, 10 solid-state techniques other than an ordinary tube, at 9,700 mits its transmitter/receiver at 20.8 GHz.

The radio carrier signal is generated by a 44 mc crystal controlled oscillator, then multiplied to 168 mc, where it is transmitter power multiplied 30 times passing through a series of parametric amplifiers, biased varactor diodes which serve as harmonic generators. In this fashion the corner signal is multiplied up to 8 GHz.

Peak 32 power output is 80 milliwatts (beam power is available at 100 per cent of the midpoint of the figure that is, peaked at 1 watt) at X-band, 3.5 watts at S-band, assuming continuous use of solid-state components throughout. Addition of parametric amplifiers could halve the 168 mc receiver noise figure.

As an X-band beam splitter consisting of two ferrite resonators configured, the



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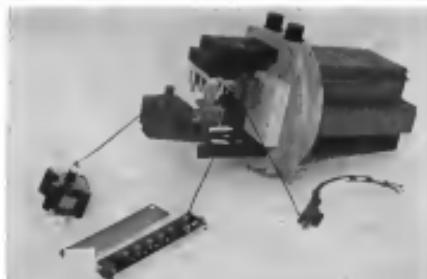
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**MOCKUP OF PULSED RADAR SYSTEM** developed by Emerson Electric Mfg. Co. for cooperative guidance shows, left to right, magnetron, transmission path, IF amplifier and electron beam modulator. Beam has a successive range of 400 cm.

value is expected to make cause range measurement to  $\pm 0.045\%$ ,  $\pm 10$  meters and five rings (below 10 kilometers) to  $\pm 0.015\%$ ,  $\pm 6$  meters. In that case Equation (1) STL says, it will range to 1,300 kilometers, measure change value

likely to 5000 deliveries with an average of 10,000 metrictons. Average earnings at 1,000 kg = \$54/kg, at 700 kg = 15 kg with single tracking, an average of 7 x 1000 kg of hoppers and an average of 1000 kg per hopper, or better, MTBF for the system, according to the company, is in excess of 1,000 hrs. Based on parts cost, cost per tonne future sales, a space element, two factors and operating time, a capital cost of \$100,000 is reasonable.

The rider employs a plane shield ascent using an improved adiabatic sign technique developed by STL to supply range economy and cabin pressure stability necessary for space guidance. Rider sensitivity is  $\pm 125$  gads.

The system deliberately has not been optimized for maximum size and weight, but was designed with sufficient articulated flexibility to meet a variety of mission or payload requirements. Weighing 2600 pounds, the ST1, estimates, the robot with its carrying cell weighs about 40 lbs. Its maximum tether, the manipulator and its interests about 90 lbs.

STL also has completed conceptual design of a dry tooling node using techniques similar to those employed in its cooperative system.

The cooperative system is designed to be compatible with any type of angle tracking.

**• Emission Electric Mfg. Co.—**An integrated radar and target transponder system was available for televisions between a moving satellite and an associated target vehicle has been proposed and is

proposed—a starboard antenna with dome, a receiver-transmitter-antenna dome, and a control display unit. The receiver-transmitter package of the radar assembly is the same as the transponder carried, along with a feed antenna, by the target vehicle.

The transmitter-receiver package,

shown in accompanying photograph, is cylindrical in shape. The transmitter consists of a line-type modulator using a hydrogen thyratron, a high-voltage power supply and a magnetron which generates the 2 kilocycles RF signal. A sensitive voltmeter isolates the magnetron from the effects of varying load on the pedastals. The receiver employs a 150-mc local oscillator, dual diode detector, double tuned coupler and a low noise input circuit for the IF preamplifier.

A tracking control servo which generates reference search patterns and positions the antenna and extracts the extracting range and angle tracking information from received signals are also housed in the same machine.

**Lightweight Instrument Laboratory**—A lightweight, passive radio transponder device that can supply weight information from 1,000 lb down to 100 lb with an accuracy of 0.05% or  $\pm 0.1$  range bin. The bin  $\pm 1$  lb/sec. is 2,000 lb. It uses  $\pm 0.05\%$  or  $\pm 0.1$  lb/sec. accuracy, plus weight and altimetry data has been proposed to use one technique for use in rendezvousing with the Apollo lunar module. It will be built by Aerobee Instruments, Los Angeles. The K-1, built by Aerobee, will have a weight of 10 lb and a size of 10 in.  $\times$  10 in.  $\times$  10 in. with  $\pm 1$  sec. and altimetry, weight, single pulse weight information to 100 lb/sec. with an accuracy of 0.1 in/sec. The scale itself, without reference null weight 25 lb, while the housing will weigh 3 lb. Power consumption will be 30 watt for

low pulse repetition frequencies, 35 fm high. Antennas will be 30-mm parabolic reflector with a gain at a range of 40 dB and a 3 dB beamwidth of 1.5 deg. Other characteristics include low pulse repetition frequency (100 Hz) pulse width of one microsec, high-pulse peak width of 0.1 microsec, pulse step variable from 4 to 1,100 nsec, power level of 2 kilowatts, -95 dBc (minimum detectable

signed for Incus video bandwidth.  
• **Worthington Electronics** in Largo, Md., pushed video-camera capability of measuring mag to an accuracy of  $\pm 1$  percent at ranges of 60 m and  $\pm 20$  ft. at short distances as being developed by Worthington Airc Arms Division, Beltsville, Md. The system is designed to give both unassisted and assisted visual weapons acquisition, tracking and guidance information. The system is said to be capable of acquiring a target and tracking it in range and range rate over a  $\pm 90^\circ$  field-of-view.

Series of one microsecond interrogating pulses at a frequency of 350 pps trigger the transponder on the satellite and its own microsecond signal, offset from radio transmitter frequency, is picked up at the chaser. The leading edge of the pulse is used for measuring range (range rate by differentiation), the remainder for azimuth, then elevation angle. Angle measurement is made by microstepping techniques.

## Space Vehicle Load

1000000000

Satellite ID / Orbit <sup>1</sup>	Name	Epoch	Period (Secs)	Apside (Secs MSL)	Perigee (Secs MSL)	Transmission <sup>2</sup>		Weighted Gds (kts)
						Freq (Hz)	Rate (Hz)	
1998 Alpha 1	Explor 1	1 Feb 10	102.0	3,040	320			34.6
1998 Beta 2	Vanguard 2	1 Feb 10	103.0	3,050	305			34.2
1998 Alpha 3	Vanguard 2	17 Mar 10	105.0	375	337			34.2
1998 Gm 1	Vanguard 2	18 Mar 10	104.0	3,250	301			34.2
1998 Mu 1 (1998)	Lonex 1	2 Mar 10	451.0	4,000	1,070,000	0.070000	0.070000	3,241
1998 Mu 2	Phenix 2	2 Mar 10	300.0	4,000	1,040,000	0.070000	0.070000	31.6
1998 Mu 3	Explor 2	10 Oct 10	101.0	345	345			30.3
1998 Mu 4	Phenix 2	11 Mar 10	311.0	8,000	1,050,000	0.070000	0.070000	34.8
1998 Beta 2	Phenix 2	1 Apr 10	97.0	360	430	100-1000	100-1000	27.0
1998 Gm 2	Trident 18	12 Apr 10	104.5	207	322			34.8
1998 Phenix 2 (1998)	Trident 18	18 May 10	96.0	350	350			16,000
1998 Mu 5	Trident 18	20 May 10	104.5	214	315			34.8
1998 Mu 6	Trident 18	22 June 10	104.0	440	399	100-1000	100-1000	32.0
1998 Mu 7	Trident 18	27 June 10	104.0	375	375			32.0
1998 Mu 8	Trident 18	12 Aug 10	107.0	1,000	940			34.0
1998 Mu 9	Trident 18	14 Aug 10	106.0	375	375			34.0
1998 Mu 10	Explor 2	2 Mar 10	102.0	1,000	940	100-1000	100-1000	34.2
1998 Mu 11	Explor 2	5 Mar 10	96.0	410	390			34.2
1998 PT 1	Trident 18	11 Mar 10	96.0	338	318			34.2
1998 Alpha 1	Strela 3	12 Mar 10	91.0	338	318			34.0
1998 Gm 1 (1998)	Venice Probe	13 Feb 10	300.0	4,000	1,070,000	0.070000	0.070000	1,419
1998 Beta 1	Explor 2	16 Feb 10	91.0	320	440			36.0
1998 Mu 12	Explor 2	17 Feb 10	90.0	320	340			34.8
1998 Mu 13	Strela 3	18 Feb 10	90.0	320	340			34.8
1998 Mu 14	Strela 3	19 Feb 10	90.0	320	340			34.8
1998 Mu 15	Strela 3	20 Feb 10	90.0	320	340			34.8
1998 Mu 16	Strela 3	21 Feb 10	90.0	320	340			34.8
1998 Mu 17	Strela 3	22 Feb 10	90.0	320	340			34.8
1998 Mu 18	Strela 3	23 Feb 10	90.0	320	340			34.8
1998 Mu 19	Strela 3	24 Feb 10	90.0	320	340			34.8
1998 Mu 20	Strela 3	25 Feb 10	90.0	320	340			34.8
1998 Mu 21	Strela 3	26 Feb 10	90.0	320	340			34.8
1998 Mu 22	Strela 3	27 Feb 10	90.0	320	340			34.8
1998 Mu 23	Strela 3	28 Feb 10	90.0	320	340			34.8
1998 Mu 24	Strela 3	29 Feb 10	90.0	320	340			34.8
1998 Mu 25	Strela 3	1 Mar 10	90.0	320	340			34.8
1998 Mu 26	Strela 3	2 Mar 10	90.0	320	340			34.8
1998 Mu 27	Strela 3	3 Mar 10	90.0	320	340			34.8
1998 Mu 28	Strela 3	4 Mar 10	90.0	320	340			34.8
1998 Mu 29	Strela 3	5 Mar 10	90.0	320	340			34.8
1998 Mu 30	Strela 3	6 Mar 10	90.0	320	340			34.8
1998 Mu 31	Strela 3	7 Mar 10	90.0	320	340			34.8
1998 Mu 32	Strela 3	8 Mar 10	90.0	320	340			34.8
1998 Mu 33	Strela 3	9 Mar 10	90.0	320	340			34.8
1998 Mu 34	Strela 3	10 Mar 10	90.0	320	340			34.8
1998 Mu 35	Strela 3	11 Mar 10	90.0	320	340			34.8
1998 Mu 36	Strela 3	12 Mar 10	90.0	320	340			34.8
1998 Mu 37	Strela 3	13 Mar 10	90.0	320	340			34.8
1998 Mu 38	Strela 3	14 Mar 10	90.0	320	340			34.8
1998 Mu 39	Strela 3	15 Mar 10	90.0	320	340			34.8
1998 Mu 40	Strela 3	16 Mar 10	90.0	320	340			34.8
1998 Mu 41	Strela 3	17 Mar 10	90.0	320	340			34.8
1998 Mu 42	Strela 3	18 Mar 10	90.0	320	340			34.8
1998 Mu 43	Strela 3	19 Mar 10	90.0	320	340			34.8
1998 Mu 44	Strela 3	20 Mar 10	90.0	320	340			34.8
1998 Mu 45	Strela 3	21 Mar 10	90.0	320	340			34.8
1998 Mu 46	Strela 3	22 Mar 10	90.0	320	340			34.8
1998 Mu 47	Strela 3	23 Mar 10	90.0	320	340			34.8
1998 Mu 48	Strela 3	24 Mar 10	90.0	320	340			34.8
1998 Mu 49	Strela 3	25 Mar 10	90.0	320	340			34.8
1998 Mu 50	Strela 3	26 Mar 10	90.0	320	340			34.8
1998 Mu 51	Strela 3	27 Mar 10	90.0	320	340			34.8
1998 Mu 52	Strela 3	28 Mar 10	90.0	320	340			34.8
1998 Mu 53	Strela 3	29 Mar 10	90.0	320	340			34.8
1998 Mu 54	Strela 3	30 Mar 10	90.0	320	340			34.8
1998 Mu 55	Strela 3	31 Mar 10	90.0	320	340			34.8
1998 Mu 56	Strela 3	1 Apr 10	90.0	320	340			34.8
1998 Mu 57	Strela 3	2 Apr 10	90.0	320	340			34.8
1998 Mu 58	Strela 3	3 Apr 10	90.0	320	340			34.8
1998 Mu 59	Strela 3	4 Apr 10	90.0	320	340			34.8
1998 Mu 60	Strela 3	5 Apr 10	90.0	320	340			34.8
1998 Mu 61	Strela 3	6 Apr 10	90.0	320	340			34.8
1998 Mu 62	Strela 3	7 Apr 10	90.0	320	340			34.8
1998 Mu 63	Strela 3	8 Apr 10	90.0	320	340			34.8
1998 Mu 64	Strela 3	9 Apr 10	90.0	320	340			34.8
1998 Mu 65	Strela 3	10 Apr 10	90.0	320	340			34.8
1998 Mu 66	Strela 3	11 Apr 10	90.0	320	340			34.8
1998 Mu 67	Strela 3	12 Apr 10	90.0	320	340			34.8
1998 Mu 68	Strela 3	13 Apr 10	90.0	320	340			34.8
1998 Mu 69	Strela 3	14 Apr 10	90.0	320	340			34.8
1998 Mu 70	Strela 3	15 Apr 10	90.0	320	340			34.8
1998 Mu 71	Strela 3	16 Apr 10	90.0	320	340			34.8
1998 Mu 72	Strela 3	17 Apr 10	90.0	320	340			34.8
1998 Mu 73	Strela 3	18 Apr 10	90.0	320	340			34.8
1998 Mu 74	Strela 3	19 Apr 10	90.0	320	340			34.8
1998 Mu 75	Strela 3	20 Apr 10	90.0	320	340			34.8
1998 Mu 76	Strela 3	21 Apr 10	90.0	320	340			34.8
1998 Mu 77	Strela 3	22 Apr 10	90.0	320	340			34.8
1998 Mu 78	Strela 3	23 Apr 10	90.0	320	340			34.8
1998 Mu 79	Strela 3	24 Apr 10	90.0	320	340			34.8
1998 Mu 80	Strela 3	25 Apr 10	90.0	320	340			34.8
1998 Mu 81	Strela 3	26 Apr 10	90.0	320	340			34.8
1998 Mu 82	Strela 3	27 Apr 10	90.0	320	340			34.8
1998 Mu 83	Strela 3	28 Apr 10	90.0	320	340			34.8
1998 Mu 84	Strela 3	29 Apr 10	90.0	320	340			34.8
1998 Mu 85	Strela 3	30 Apr 10	90.0	320	340			34.8
1998 Mu 86	Strela 3	1 May 10	90.0	320	340			34.8
1998 Mu 87	Strela 3	2 May 10	90.0	320	340			34.8
1998 Mu 88	Strela 3	3 May 10	90.0	320	340			34.8
1998 Mu 89	Strela 3	4 May 10	90.0	320	340			34.8
1998 Mu 90	Strela 3	5 May 10	90.0	320	340			34.8
1998 Mu 91	Strela 3	6 May 10	90.0	320	340			34.8
1998 Mu 92	Strela 3	7 May 10	90.0	320	340			34.8
1998 Mu 93	Strela 3	8 May 10	90.0	320	340			34.8
1998 Mu 94	Strela 3	9 May 10	90.0	320	340			34.8
1998 Mu 95	Strela 3	10 May 10	90.0	320	340			34.8
1998 Mu 96	Strela 3	11 May 10	90.0	320	340			34.8
1998 Mu 97	Strela 3	12 May 10	90.0	320	340			34.8
1998 Mu 98	Strela 3	13 May 10	90.0	320	340			34.8
1998 Mu 99	Strela 3	14 May 10	90.0	320	340			34.8
1998 Mu 100	Strela 3	15 May 10	90.0	320	340			34.8
1998 Mu 101	Strela 3	16 May 10	90.0	320	340			34.8
1998 Mu 102	Strela 3	17 May 10	90.0	320	340			34.8
1998 Mu 103	Strela 3	18 May 10	90.0	320	340			34.8
1998 Mu 104	Strela 3	19 May 10	90.0	320	340			34.8
1998 Mu 105	Strela 3	20 May 10	90.0	320	340			34.8
1998 Mu 106	Strela 3	21 May 10	90.0	320	340			34.8
1998 Mu 107	Strela 3	22 May 10	90.0	320	340			34.8
1998 Mu 108	Strela 3	23 May 10	90.0	320	340			34.8
1998 Mu 109	Strela 3	24 May 10	90.0	320	340			34.8
1998 Mu 110	Strela 3	25 May 10	90.0	320	340			34.8
1998 Mu 111	Strela 3	26 May 10	90.0	320	340			34.8
1998 Mu 112	Strela 3	27 May 10	90.0	320	340			34.8
1998 Mu 113	Strela 3	28 May 10	90.0	320	340			34.8
1998 Mu 114	Strela 3	29 May 10	90.0	320	340			34.8
1998 Mu 115	Strela 3	30 May 10	90.0	320	340			34.8
1998 Mu 116	Strela 3	1 Jun 10	90.0	320	340			34.8
1998 Mu 117	Strela 3	2 Jun 10	90.0	320	340			34.8
1998 Mu 118	Strela 3	3 Jun 10	90.0	320	340			34.8
1998 Mu 119	Strela 3	4 Jun 10	90.0	320	340			34.8
1998 Mu 120	Strela 3	5 Jun 10	90.0	320	340			34.8
1998 Mu 121	Strela 3	6 Jun 10	90.0	320	340			34.8
1998 Mu 122	Strela 3	7 Jun 10	90.0	320	340			34.8
1998 Mu 123	Strela 3	8 Jun 10	90.0	320	340			34.8
1998 Mu 124	Strela 3	9 Jun 10	90.0	320	340			34.8
1998 Mu 125	Strela 3	10 Jun 10	90.0	320	340			34.8
1998 Mu 126	Strela 3	11 Jun 10	90.0	320	340			34.8
1998 Mu 127	Strela 3	12 Jun 10	90.0	320	340			34.8
1998 Mu 128	Strela 3	13 Jun 10	90.0	320	340			34.8
1998 Mu 129	Strela 3	14 Jun 10	90.0	320	340			34.8
1998 Mu 130	Strela 3	15 Jun 10	90.0	320	340			34.8
1998 Mu 131	Strela 3	16 Jun 10	90.0	320	340			34.8
1998 Mu 132	Strela 3	17 Jun 10	90.0	320	340			34.8
1998 Mu 133	Strela 3	18 Jun 10	90.0	320	340			34.8
1998 Mu 134	Strela 3	19 Jun 10	90.0	320	340			34.8
1998 Mu								

Notes: <sup>1</sup> Orbital elements of older satellites given in Astronomical Units, approximately 10 million mi; <sup>2</sup> Frequency given with respect to satellite ID 10000001; <sup>3</sup> Military satellite entry codes, which was made effective in late 1981. provides official designations or characteristics of military space vehicle launches. Satellites in this category are USA-2000, USA-10, USA-11 and USA-12 and Cessna weight = 0.2. <sup>4</sup> It has launched all satellites except those noted USA-20. And payload was joint D. E. and United Kingdom development. Previous line was published Nov. 18, 1981.

**Source:** National Aerospace and Space Administration Operations Control Center, North American Air Defense Command (NORAD), and  
Rockwell International Astronautical Operations Center.



THE SERVICE TRAINING V/STOL TRANSPORT, flying back by Ryan (shown with wings and tailfin). Designed to transport troops, cargo and weapons, the V-168-VT will be produced to meet Army, Navy and Air Force logistical requirements.



RYAN V-33 V/STOL, vertically short jet V/STOL aircraft, was developed under Air Force and Navy contracts dating back to 1968. This was first aircraft to demonstrate the feasibility of vertical jet take-off and transition to level flight.



RYAN V-22 V/STOL, a research aircraft designed, built and flown by Ryan for the U.S. Army and Office of Naval Research. It uses prop-jet engines and airstream deflected by large wings that facilitate STOL take off and landing.

## How to get maximum performance from V/STOL aircraft?

The Ryan V/STOL engineering team has the answer. With three million engineering manhours devoted to four vertical take-off research projects, Ryan is the world's most experienced and knowledgeable specialist in high speed V/STOL aircraft.

Newest and most advanced of these projects is the U.S. Army's VZ-11 research aircraft now being designed and built by Ryan. Powered by General Electric's lift-fan propulsion system, it will be capable of vertical take off, yet cruise in normal flight at more than 500 mph. The VZ-11 concept provides maximum jet thrust augmentation for take-off (engine thrust is multiplied 3 to 1 for vertical flight).

In many space age areas, flexible fast-moving Ryan is making significant contributions. Ryan is the world's largest designer and producer of Doppler navigation systems and jet target drones. Among other Ryan activities are Film Wing applications, electronics systems for lunar landings, and structures for space vehicles.

At Ryan Aerospace and Ryan Electronics, technical and management capabilities are designed to assure compliance with the most stringent standards.

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**BEECH MODEL 23 MUSKETEER** shows typical compact design lines. Four-place cabin monoplane at 115 mph at 7,000 ft, at 75% power.

*Aviation Week Pilot Report:*

## Musketeer Blends Simplicity, Versatility

By William S. Reed

Wichita, Kan.—Fewer flights in the Musketeer, Beech Aircraft Corp.'s new model for a share of the low-power aircraft market, will be demanded by the *Pilot* Cherokees and Comets 172, evidently the aircraft is meant to handle with performance and range enough for a wide variety of business, tourism and pleasure flying uses.

Principal features of the Model 23 Musketeer, which Beech will release to dealers next fall are:

- **Large, spacious cabin.** The Musketeer has a 7-ft. wide, 7.81 ft. long by 5 ft. 11 in. wide. The Musketeer has an additional 15.5 cu. ft. of baggage space aft of the rear seat with no external access door.

- **Reliable, fuel efficient landing gear** with rubber disk shock absorbers and dual-wheel hydraulic brakes. Total weight of the rear gear is 116.6 lb. and wheel base is 6.5 ft.

- **Cruising speed of 115 mph at 7,000 ft using 75% power.** At that power setting, the Musketeer has a range with reserves of 585 mi.

- **Price tag of \$13,300** including all essential instrumentation, a complete radio installation and eight lighting equipment (AW May 28, p. 17).

The Musketeer represents a departure in Beech thinking in more than one respect. Designed as the start in a low-power aircraft, the engineering effort has been aimed at producing an aircraft which will meet production costs

including safety, durability and apparent economy. Project Engineer John J. Ellett says that the Musketeer parts list includes only 3,000 items compared with more than 3,800 for the Bonanza. Beech has kept the cost down by using a large number of standard parts, such as those of the standard aircraft, and by using a light weight of bonded aluminum, honeycomb and sheet metal in the wing, which forward of the main spar (AW Dec. 4, 1961, p. 94) which yields in an extremely smooth ride 50 lb. lighter than conventional construction.

Other major innovations include a tricycle landing gear, the nose components of which are slanted. Not only are the wheels interchangeable but so are the static, landing and shock shakers. The complete engine assembly plus firewall and excluding the nose gear assembly is designed to be disconnected from the fuselage in about 10 minutes.

Advantage here is that nose gear, in the cabin, both front and rear seats is gained through a large opening on the right side of the fuselage. A third and important of the Musketeer's features is the unique monoplane tail assembly, the main tailplane being mounted on the fuselage. The rear is treated 2 deg. 1 deg. of lead/lag at the root to keep the tail well behind the main tail and allows control rotation of both tail appendages. Wing tips are designed for toe replacement and are made from molded glass fiber with built-in navigation lights.

Emergency controls of a swept fin and rudder and a low-mounted stabilizer (one place consideration stabilizer elevator) with a trimmable aileron/satellite for antivibration feed back. Principal advantage of the emergency stabilizer is

the extra work force had to be assembled to assemble the aircraft. The Model 23 is a low-cost aircraft and it will represent a more modern approach than is used with the standard aircraft.

Even in the Musketeer's pleasure to fly and while it may be easier and less expensive than other Beech products, it stacks up well to comparable well-conceived aircraft in the same price range.

The Musketeer sits low to the ground but not so low that operation in reasonably rough terrain would be prohibited. Propeller tip clearance is 34 in., enough for taking such large ground irregularities as trees.

Entrance to the cabin, both front and rear seats is gained through a large opening on the right side of the fuselage. A third and important of the Musketeer's features is the unique monoplane tail assembly, the main tailplane being mounted on the fuselage. The rear is treated 2 deg. 1 deg. of lead/lag at the root to keep the tail well behind the main tail and allows control rotation of both tail appendages. Wing tips are designed for toe replacement and are made from molded glass fiber with built-in navigation lights.

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**WISE TREAD** of Musketeer is evident in photo of landing at Beech Airport, Wichita, Kan. Flying above the Musketeer is a Model 33 Ethanair. Musketeer's wingtip flaps are usually operated with two positions—15 and 30 deg. Musketeer touches down at 65 mph with flaps. Bringer system incorporated in Musketeer can be inhibited with during deliberate trim control movements such as crosswind landing. Nosewheel is a control but is not steerable. Light bridle tipping a cockpit.

that a smaller area is required with a corresponding saving in weight and drag. Stabilizer tips also are of glass fiber.

Instrument panel of the Musketeer is large and accommodates engine and flight instruments in front of the pilot with radio gear in the center. All instruments, except the radio, are mounted gyro-free except the basic ones. Also included in the VHF antenna radio including autopilot and cabin speaker. The radio includes:

- Separately variable 100 channel crystal-controlled communications receiver (106.8 to 117.9 mc).
- Bothies mono-tube converter and indicator.

Starter switch for the 160-hp Lycoming O-360-B engine is enclosed in the left cockpit quadrant of automobile design.

Timing is accomplished with differential braking through no-operated hydraulic brakes. The nose wheel, although steerable, is not steerable. The Musketeer can easily be maneuvered on the ground even though sharp turns because of the tailwing moment imposed by differentially braking the main wheels. On straight, long stretches of running, the nose will even make turns having turns even at low speed making repeated bank applications unnecessary.

Takesoffs on the English made by *AVIATION WEEK* were to the north of the elevation of Beech Airport at 1,713 ft.

The temperature was 87°. With fuel load at a minimum of 60 gal and Beech Test Pilot Vaughn D. Gandy and *AVIATION WEEK* pilot aboard, the gross weight of the Musketeer was 2,095 lb. The extra cargo or passengers could have been carried to bring the total to 2,160 lb. for normal gross weight.

Lack of wheelwell steering caused some apprehension that perhaps a little braking action might be needed during the takeoff roll but the initial action in the propeller slipstream was effective enough to keep the aircraft aligned with the runway even at the outset. Some moderate bridle tipping might be necessary in a strong crosswind, as is the case with most tricycle gear aircraft and the Musketeer does not differ. Crosswind takeoff would appear to be not materially different, however.

Back pressure on the wheel when the autopilot skewed about 60 mph began to reduce and the Musketeer flew off the ground at 65 to 70 mph. Takeoff roll was about 650 ft. The aircraft was allowed to accelerate to a bar climb speed of 83 mph, at which point the rate of climb indicated 750 fpm over



**PROTOTYPE AIRCRAFT** instrument panel clearly matching that available on Musketeer production models, shows all flight and engine instruments grouped in front of pilot.





## ARMY IROQUOIS CLAIMS THREE MORE RECORDS

**TIME TO CLIMB** . . . 6,000 meters (19,688 feet) in 8 minutes, 51 seconds.

**TIME TO CLIMB** . . . 3,000 meters (9,843 feet) in 2 minutes, 14.6 seconds.

**SPEED RUN** . . . 1,000 kilometers (621.4 miles) with top speed of 150 mph . . . average 136.9 mph.

Faster climb . . . higher speed . . . greater range . . . demonstrate the Iroquois' outstanding performance capability at all tactical altitudes. With these three new records, Bell now holds or claims 63% of all helicopter records held by U.S. manufacturers—36% of all world helicopter records. Bell commends the Army Aviation Board's plan for establishing these marks. The Iroquois used was a 15-place YHU-1D helicopter, powered by a 1,100 hp Lycoming T-53-1B gas-turbine engine. In its speed run, using a standard auxiliary fuel tank, the HU-1 demonstrated its forty range which exceeds 700 miles. Other services can get more helicopter performance for their dollars, too, with the HU-1. It has the inherent flexibility to meet today's mission requirements, and is now being phased into production ready for off-the-shelf procurement.

LOOK TO  
WORLD  
STANDARD  
**bell**  
HELICOPTER  
COMPANY

FOR RECORD BREAKING PERFORMANCE

YOH-1D Iroquois rotates a searchlight  
pilot during the speed run.

  
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A  COMPANY

TEXAS

since they were easily topped during flight. For example, Bell's figures show a true speed of 135 mph at 7,000 ft, pulling 2,600 rpm at 25% power. The record-setting endurance Modèle 200, by American West, N1532R, showed a true speed of 140 mph. Gross weight was less than maximum, but the barometric temperature at 7,000 ft was 14°C, above IBC above standard, so apparently the cruise performance figures, if correct at all, are on the conservative side. Fuel consumption in the power phase setting was 9 gph, which would have yielded a range in excess of 400 km with maximum. Other speed power data taken on the flight—2,700 rpm—the true speed was 145 mph. At 2,700 rpm true speed was 150 mph and 2,400 rpm brought 139 mph TAS.

### Stall Procedures

Stalls on the Model 25 are straightforward and require the application of no unusual techniques.

With a favored center of gravity, that is without passengers in the rear seat, the Modèle cannot be trimmed out at an airspeed lower than 90 mph, and that results in a considerable stall force being required during power stalls even with full nose-up trim. Therefore it is a safety feature that the rudder is limited to an attitude that is at the upper limit of the rudder's travel. This is to prevent the aircraft from flying off the tail. The Modèle will stall and drop off with full back elevator but the nose immediately drops forward and flying

speed is restored. If the wheel is held up, a series of very rapid stalls results, though each which releases and reduces control is retained.

Power-on stalls are similarly well. Again, it is not possible to have the aircraft trimmed so that a tail-down application of power will result in a too horizontal pitchup attitude with the possibility of an unfeathering stall. And even with rudder control as retained at post-stall speeds with power on, it will not power on. Additionally, the rate required to produce a power-on stall is very strong, leading again to the conclusion that an inadvertent power-on stall would be unlikely.

In addition to a stall-warning fairing around the cockpit, the Modèle is equipped with a stall-warning indicator which sounds a horn approximately 5 mph above actual stall. Thus, power-on, the stall warning occurs at 65 mph with the horn sounding at 65 mph. Power off, the Modèle stalls at 65 mph, flies up at 62 mph, with 30 mph of flap.

Landing the Modèle requires nothing in the way of extraordinary skill. The pattern can be flown at 100 to 110 mph and the aircraft handles easily at those speeds. Thus it is flown below 110 mph by a handle located on the floor between the front seats. The pattern, identified by the banking of a

## RICHMONT—THE ONLY COMPLETE TORQUE CONTROL SYSTEM

**Model RT 1450**  
How it sits in  
industry's one  
and only aircraft  
torque system.  
Specification  
MIL-M 9512  
(FAR 23)

### This Complete System Includes:



- Four Torque Handles.
- Handle ranges (in lb.)  
3 to 200—50 to 250—  
150 to 750—400 to 1800
- Torque limiters (in lb.)  
100 to 1200 in lb. 1000 lb.
- Universal adapter for all tail and  
main drives from "W" to "Z".
- Full range of NEMA Motors.  
Interchangeable to all tail drives.
- Self contained in its own integrated carrying case.

The Richmont system is the only completely integrated method of tailoring, maintaining, and checking torque torque to engineering specifications right on the job.

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## PRIVATE LINES

Hall ionizer program sponsored by Aerospace Molybdenum Institute Co. provides lower rates on British 8.7 heliophiles. New rates are 85¢ for passenger and business use and 119¢ for commercial use and use applicable to all British machines. The rates are effective immediately.

Minnesota Twins, American League baseball club, will be at a 6:05 p.m. flight at Union City Airport, Hopkins, Minnesota. Peter Arneson, manager of the Twins, will be the Cleveland Indians. The event is being jointly sponsored by the Minneapolis Chamber of Commerce and the Minnesota Airport Operators Assn.

Fent Creek Skybox to be used in widespread operating operations, recently signed 6,000 acres of sage brush near Durango, Colo., for the U.S. Forest Service. The helioglyph is operated by Sis Hack, Inc., of Durango. Spending on contract of 20.9¢, spent hours on each side of the helicopter and two H-130 spruce sprays. Present is supplied by centrifugal pump powered by a gas engine. Use is Federal Aviation Agency approved.

Modifications of Lockheed JetStar executive turboprop transport, designed by Garrett Corp.'s Aerospace Division Senior Vice Div., have added about 25% to the cargo capacity of the aircraft's cargo compartment and reduced cabin noise, the Garrett division says. The JetStar's interior has been moved from the floor of the cargo compartment to a space forward of the nose gear well. Aerospace has designed a closed interior compartment which is pressurized, soundproofed and sealed with the circuitry of cabinization system. Cargo compartment was designed to reduce ramble caused by turbulent flow of ambient air entering the aircraft's interior. Also included in the modifications are an auxiliary rear cargo window mounted in a molded frame of heat plastic foam and a sealed glass fiber blanket installed on the cabin at cabinizing. Modification work has been done on JetStar owned by Felt Motor Co., Commercial Oil, Septon, Oil, T. Eaton, Cessna, Iron Works and Textron.

Piper Aircraft Corp. delivered in May modified 205 aircraft with a factory net selling value of \$5,298,537. Included were 12 Super Cubs, 11 Comets, 38 Aerocars, 6 Comanche 180s, 27 Comanche 250s, 27 Cherokee 150s, 12 Cherokee 160s, 16 Cherokee 150s and 46 Cherokee 250s.

## U.S. Business & Utility Plane Shipments

April 1962

Model	Units	Net Selling
All Commer. 100-8	1	\$70,000
Boeing 707	11	
707-300	11	\$10,000,000
707-320	1	
707-330	1	
707-340	1	
707-350	1	
707-360	1	
707-370	1	
707-380	1	
707-390	1	
707-400	1	
707-410	1	
707-420	1	
707-430	1	
707-440	1	
707-450	1	
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707-630000	1	
707-640000	1	
707-650000	1	
707-660000	1	
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707-910000	1	
707-920000	1	
707-930000	1	
707-940000	1	
707-950000	1	
707-960000	1	
707-970000	1	
707-980000	1	
707-990000	1	
707-1000000	1	

## U.S. Business & Utility Plane Shipments

April 1962

Model	Units	Net Selling
All Commer. 100-8	1	\$70,000
Boeing 707	11	
707-300	11	\$10,000,000
707-320	1	
707-340	1	
707-360	1	
707-380	1	
707-400	1	
707-420	1	
707-440	1	
707-460	1	
707-480	1	
707-500	1	
707-510	1	
707-520	1	
707-530	1	
707-540	1	
707-550	1	
707-560	1	
707-570	1	
707-580	1	
707-590	1	
707-600	1	
707-610	1	
707-620	1	
707-630	1	
707-640	1	
707-650	1	
707-660	1	
707-6		

# INTERNATIONAL AIR TRANSPORTATION ISSUE

## SEPTEMBER 10, 1962

The impact and challenge of recent trends and developments in international air transportation will be the subject of AVIATION WEEK & SPACE TECHNOLOGY's *International Air Transportation Issue*, September 10, 1962.

This major editorial effort will analyze the direction and problems associated with the growth and expansion of air transportation in all major world markets including Atlantic, Europe, South America, Africa and Asia.

Subjects slated for special emphasis are: Development of a new U.S. international air policy; Worldwide impact of common market and African consolidations; New flag carriers of emerging nations; New trends in supersonic transport research; Communist bloc penetration in world air markets; 1962 traffic trends; and future international tariff and merger problems.

Copies of this issue will be airlifted to delegates at the opening session of the International Air Transportation Association (IATA) Conference in Dublin, Ireland. Here will be gathered the international leaders of air transportation whose attention and discussions will be focused on these and other major issues.

With AVIATION WEEK's reputation as the authoritative, respected voice of international aviation, the International Air Transportation Issue will receive world-wide readership and impact.



### Aviation Week 4 Space Technology

A McGRAW-HILL PUBLICATION  
333 N. 42nd St., New York 26, N.Y.



Grumman Aircraft Engineering Corp.'s 90-ton Demco hydrofoil road reaches 50 kt. with just 5 ft. above water in Long Island Sound.

### Grumman Hydrofoil Reaches 50 kt. in First Test



Ship is 184 ft. long, has complete aluminum construction, uses two General Electric MS-240 jet turbine engines. Current speed capability is 50 kt., and high-speed test version under development will exceed maximum speed to 60 kt. After steel hull weighs 14 tons each are hydrodynamically optimized, and retract by emerging instead of upward. Propeller is located at port at bottom of stern foil.



Sixty-passenger road, presently a hydrofoil research ship, also will be used in 1963 to carry tourists between Florida and Bahama



What is the righteous digit of  $21^7$ ?

—Contributed

For your R. E. J. research you might want to try our Electron Tube Division's portable microcosm of power source Model 218. Pulse-value CW and MCW power available from 50 to 500 watts or pulse capabilities varying from 32 to 2,000 with peak power, 10 to 10,000 microseconds pulse length, and 10 to 10,000 cycles pulse rate. Operates within the frequency ranges from 475 to 725 and 975 to 10,475 megacycles. Other applications: component testing, antenna range setting, and the use as a driver. Basic data and figures available from the Marketing Department, Electron Tube Division, San Carlos, Calif.

ANSWER TO LAST WEEK'S PROBLEM: 45 different routes. Letting  $x_1$  and  $x_2$  represent respectively the paths of direct routes from  $A$  to  $B$ ,  $B$  to  $C$ , and  $C$  to  $A$ , we have the following equations:

$$x_1 + x_2 = 42, \quad Y = x_2 = 62.$$

These two equations give

$$Y = \frac{42(11 + 25)}{45} = 21.2,$$

which gives rise to three values of  $x_1$  of 3.3, 11, and 11 with corresponding solutions 47E, 30J, and 46. Only the latter meets the conditions of the problem.

**LITTON INDUSTRIES, INC.**  
Beverly Hills, California

## FINANCIAL

### New Offerings

Eng-Tech-Vought, Inc., Dallas, Tex., engaged in the design, development and production of military aircraft and missiles, electronic products and electro-mechanical and control equipment and other products. Offering a \$4,817,200 of outstanding 9.5% subordinated convertible debentures due 1976, the public sale to James Lang, vice chairman of the board. Mr. Lang also agreed to sell from time to time all or part of warrants originally issued to purchase an aggregate of 1,901,000 common shares of \$35 and \$40 per share.

The debentures to be offered were issued in part by Mr. Lang upon sale of his option shares of Chance Vought Corp. owned by him in connection with the complete liquidation of Chance Vought following sale of 45% assets to the company in August, 1961, and in part issued to him upon conversion of debentures of Chance Vought issued to him and assumed by the company in connection with the purchase of said assets.

Berkshire International, Inc., Washington, D. C., organized in 1968, engaged in the manufacture of high class electronic components, is one of the leading producers of berthium products; the company has acquired a network of manufacturing facilities in a plant near Hillside, Mass., and a number of mining properties. Of these, a 1,000,000 tonnes share at \$5 per share. Of the proceeds \$419,000 will be used for real estate and buildings, \$2,163,000 for equipment, \$931,000 for working capital.

OPTEKHEM, Inc., Pleasantville, N. Y., engaged in research, development and manufacture of electric-spiral precision and electronic instruments for scientific and the military, avionics, has recently planned \$175,000 of 6% nonconvertible subordinated debentures, the Feb. 1, 1972. Proceeds will be used for new product development, research, capital equipment and general corporate purposes.

New York Testing Laboratories, Inc., New York, N. Y., engaged in testing and analysis of electronic, chemical and other materials, manufactured items and structures. Offering a \$10,000,000 share at \$5 per share. Proceeds of the sale will be used to move the company's plant to Nassau County, N. Y. and to purchase new equipment for environmental and other testing including a medium wave vibration test

## AVIONICS

### Anti-Collision System Concept Reported

By Philip L. Kline

Washington—New details on a collision avoidance system technique based on the use of a precision airborne frequency reference were disclosed here last week by the National Co. at the Federal Aviation Agency sponsored subcommittee meeting.

The company, which has filed for patents on the basic concept, is under FAA contract to conduct flight tests later this year to evaluate feasibility (AVW Mar. 7, p. 67). This criteria is to be met in order to determine whether to proceed to development and to flight tests.

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loss per day. While this is a significant accomplishment for a small aircraft, it would cost a drift of about one second over three hours.

For short duration domestic flights with atomic clock calibration facilities at the airport no modification of the radio payload before take-off, such drift rates should be adequate. But for long non stop flights of six hours, the accumulated drift would be equivalent to a 2,000 ft error, or 1,000 ft for two months inched in a culture threat situation where both had been airborne for six hours without refueling.

Also, drift in the airborne frequency standards would result in errors in measuring elongation rate by Doppler shift measurement.

#### Small Atomic Clock

One solution for long flights would be to use an atomic clock whose drift rate is only 1/10th to 1/100th as much as the best crystal oscillator.

Based on performance design work, Nierenberg believes it can build an atomic atomic clock, fully miniaturized which would weigh about 20 lb, except about one cubic foot, and sell for approximately "several thousand dollars" in quantity production. It would have a stability of one part in 100 billion hours according to present estimates. Aviation Week was told. The cost per shade has not the price of atomic clock systems, but from their current figure of about \$100,000 to \$110,000 for a complete model produced in quantities of 16 units.

Using an atomic clock in each aircraft, the airborne system would need to be synchronized only once per day. This could be done quickly using a more passive atomic clock matched at major airports while the aircraft was at the end of the runway waiting to take off.

But for smaller aircraft, an atomic clock may be too expensive and bulky.

Nierenberg has devised an alternative which would use a low-cost airborne crystal oscillator plus a network of ground stations that periodically would update the aircraft oscillator. Such a calibration ground facility, synchronized with previous atomic clocks, might be located at present VOR/LOC sites.

Here is how such a system might operate. Each aircraft would have a signal with a specific time slot for transmitting its position, heading, altitude, Present thinking is that the time slot would be about five milliseconds in duration. The message would include a series of binary coded pulses indicating aircraft kinematic attributes. Each aircraft would repeat its warning message transmission once every second for perhaps one second, then remain silent for one second to receive ground

transmitted synchronization signals.

The purpose of the ground signal is to provide each aircraft with an accurate time reference for both its own clock and airborne housing. For this reason, one has drift to assure that each aircraft transmits its synchronization message at the correct time due.

If the ground stations transmitted a single time update signal to all aircraft simultaneously, it would arrive at each aircraft at a different time since each is at a different distance from the stations due to signal travel time. Upon power-up power-up, one microsecond per person and fast.

One solution to this problem is to transmit an individual synchronization message to each aircraft timing its transmission so that it arrives at the intended aircraft at the desired instant. This requires that the ground system measure the distance to each aircraft, which can be obtained by the aircraft's transponder receiver or connected to function in a DME/DME transponder during the synchronization period.

For example during the one second synchronization period, each aircraft's time would be good as to as to as to a transponder to any ground station in transmission interval during its assigned time slot (which it overall transmits in writing message). The individual aircraft transmits back the received pulse and the ground station can thus determine aircraft distance from the two most major time.

Knowing the distance to the aircraft the ground station can then determine at what time the subsequent update message should be transmitted in order to reach aircraft in time to arrive at its predicted time. At the appropriate instance of synchronization later, the ground station transmits the synchronization message to this aircraft. It then repeats the cycle until a self-cell of all assigned time slots and aircraft has been completed.

#### Alternate Approach

An alternate approach would be to have the ground stations receive a single synchronization message by all aircraft at specified times and have the aircraft use an internal DME to determine distance to the station and to compute precisely for signal transmission.

Each ground station synchronization signal provides instantaneous synchronization of the airborne oscillator but does not provide correction of the basic oscillator drift. However, by storing and integrating a sufficient number of such measurements, the airborne oscillator could determine the approximate range, attitude and direction of its oscillator drift and introduce necessary compensation.

Some observers believe that the sys-



WHY YOUR  
COMPANY  
SHOULD OWN  
A GULFSTREAM

Gulfstream's short-field, superjumbo enables it to use more than 1,200 airports in the United States and Canada, bringing its passengers closer to departure and arrival points. Add to this complete independence of ground landmarks, and you get a nonstop cruise rate, average speed of 500 mph to 30,000 feet, and an operating rate lower than piston-engine aircraft. That's Gulfstream flexibility.

Long flights? With leading corporations expanding their world markets rapidly, transoceanic flights are commonplace in Gulfstream operations. Today, you might see Gulfstreams in Japan, Australia, South Africa, India, Spain, Germany, England and a score more countries.

Powered by Rolls-Royce Dart turboprop engines, Gulfstream fly at intermediate and jet altitudes and, with constant operating rates, can fly in "thin air" as well. Of the many companies operating Gulfstreams today, some have added a second Gulfstream to their business fleets. Your company and the FAA have added a third. Flexibility, Performance, Costless. These are the things that make the Gulfstream the ultimate in business airplanes.

For demonstration contact: Atlantic Aviation, Wethersfield, Del.; Pacific Aviation, Santa Monica, Calif.; Southwest Aviation, Dallas, Tex.; Thomas Aviation, Montreal, Can.



**GRUMMAN**  
AIRCRAFT ENGINEERING CORPORATION  
Bethpage • Long Island • New York



The standard in business aviation \*\*\* Corporations of all sizes operate Gulfstreams for business purposes. \*\*\* Large and small, what is common to all these dynamic, growing companies is the fact that they recognize the corporate airplane as a powerful business tool. Their choice of the Grumman Gulfstream has helped establish it as the world's standard in corporate transportation. \*\*\* Grumman Aircraft Engineering Corporation \*\*\* Bethpage, Long Island, New York.



## SIZE 11 WINDING-COMPENSATED SYNCHRO RESOLVER

Precision, lightweight, high accuracy components with applications in analog computers and automatic control systems. The compensator winding provides feedback voltage for a resolver isolation amplifier, the feedback loop automatically adjusts to compensate for temperature and frequency variations. Function error of the R950-01B is only 0.1%. A compatible temperature amplifier, Model No. 88100-01A, is available.

Part Number	SPR950-01	CRS 9500-000	CRS 9500-000
Combination Input (mV)	60	20	20
Frequency Input	400	400	400
Total Hall Voltage (mV)	20	20	20
Max. Error from 0-2° Deviation	5	5	5
Resonant Frequency Range	10-30 Hz + 120°	-30 Hz + 120°	-30 Hz + 120°

For complete data write Kearfott Division, General Precision, Inc., Little Falls, New Jersey.



## KEARFOTT

### DUAL- CHANNEL TRANSISTORIZED BUFFER AMPLIFIERS

These high-performance units are designed to drive Kearfott's Size 11 R950 winding-compensated synchro resolvers. The amplifier-resolver combination has stable gain characteristics and negligible phase shift through an ambient temperature range of -50°C to +85°C. Extremely high resistance to shock and vibration. Meet environmental requirement of MIL-E-5272.

Part Number	SPR950-01	SPR950-02
Number of Inputs	2	2
Input Impedance	100 MΩ	100 MΩ
Output Impedance	100 MΩ	100 MΩ
Power Supply Input to Input at 25°C	100 mV	100 mV
Power Supply Output Voltage	100 mV	100 mV
Power Supply Output Temp Range	-50° to 85°C	-50° to 85°C

For complete data write Kearfott Division, General Precision, Inc., Little Falls, New Jersey.

## GENERAL PRECISION

to another. Shortly after passing Allentown the flight started its descent to 15,000 ft and continued to a landing at 10,000 ft at 10:45 a.m. on Victor 125. This was causing thousands of the passengers in the Pan Am Intercontinental to spontaneously yell out loud. However, it did not affect the Pan Am clearest heat. The New York Center advised United 826 to make that port turn and descend to 10,000 ft and then descend to Victor 10 and then turn 45° to descend to and descend to 10,000 ft. Subsequently United 826 was advised by New York Center that it was crossing the center line of Victor 30. United 826 continued establishment on Victor 30 and expected to be cleared from Victor 125. The New York Center advised that the flight was 10 and 1/2 miles from Victor 10 and about 1/2 mile crossing Victor 110. The estimators during the proximity to Victor 121 and the Pan Am Intercontinental should have alerted the United crew of the rapid approach to the clearance limit.

When United 826 was established on Victor 30, the flight was 10 and 1/2 miles from the flight to descend to 10,000 ft. United 826 acknowledged and reported leaving 14,000 ft. New York Center then advised if United 826 could make Pan Am at 10,000 ft. United indicated it would. A controller of control could be offered to璧dwell Approach Control and United 826 was cleared 10,000 ft.

When United 826 was cleared to descend to the clearance limit the New York Center provided holding instructions for the Pan Am Intercontinental. The flight was advised at this time that the rate delay would be in the descent. United 826 reported leaving 10,000 ft and 6,000 ft. United's report leaving 6,000 ft was acknowledged by New York Center which then instructed the flight to contact璧dwell Approach Control. New York Center did not receive radio return from United 826. United 826 was doing an easy maneuver and the radio return that was received was in the form of dashes. United 826 connected璧dwell Approach Control and was approaching Pan Am at 5,000 ft. When United 826 advised approaching Pan Am, it had already passed Pan Am by several miles. In accordance with the instructions related to璧dwell Approach Control by the New York Center, United 826 was cleared to descend to 10,000 ft and then 6,000 ft. However, the reported clearance in Victor 121 would have United 826 approaching from the southwest. This was not what was advised by the New York Center to璧dwell Approach Control.

The two units would normally be cleared to descend to 10,000 ft and then 6,000 ft in an effort to identify any possible proximity. Pan Am 100 had been known to make a similar descent. According to the pan Am report transmitted by United 826 and the clearance limit issued by ATC, the approach would have extremely expected to receive a major approaching Pan Am. No major was issued. ATC must have been aware of the Pan Am's position established by the controller before calculations are commenced. Positive radio contact is accomplished by several means:

- By the aircraft reporting over a known radio site which the controller has described as his scope.
- By monitoring the heading of an aircraft

and requesting a turn in a designated lead for identification.

• By a coded Beacon transponder response. A radio transponder would be effected in accordance with the requirements of the clearance limit. The body becomes New York Center and璧dwell Approach Control would simultaneously observe the altitude during these procedures and the controlling facility would not attempt control until the aircraft had been positively identified. It was noted that radio handoff was as the approach rather than the traffic control section. Radio handoff was not a part of the function of the controller with radio communication being handled by the traffic control section in case of emergency. A radio handoff was not advised by璧dwell Approach Control.

Since United 826 did not advise ATC of a failure of a component or components of the No. 2 radio system or return radio transmission, ATC could only assume that he was capable of providing his own navigation.璧dwell Approach Control had a positive radio handoff procedure by New York Center and璧dwell Approach Control.

### Air Traffic Control

Victor Approach 121, upon which United 826 was proceeding, was cleared and cleared to 10,000 ft above ground level by LaGuardia and璧dwell Approach. Under IFR, aircraft traversing the service are controlled by the New York Air Route Traffic Control Center. Under VFR weather conditions, aircraft may traverse the service without an ATC controller as a whole crew ATC would not have knowledge of an incoming aircraft, altitude, orientation, or identification. Further, air traffic procedures do not provide for the separation of en route IFR and VFR traffic except in designated points of contact airspace. In view of the fact that the aircraft in the New York service area,璧dwell Approach, during the period 1000 to 1100 on Dec. 16, 1969, consequently the aircraft operated by璧dwell Approach Control did not have a flight plan or point on the uncontrolled traffic. They were aware that the traffic on Victor 121 was not cleared for them as part. In order to have been certain of the destination of the uncontrolled aircraft, the approach controller would have to request the information from the New York Center. It is concluded that璧dwell Approach Control could have established communications with the New York Center, identified the aircraft and transmitted traffic information in approximately 10 sec. The only immediate alternative action that could have



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## GENERAL PRECISION

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loss rates in the LaGuardia Approach Control would have been to provide visual cues to TWA 266 or the controllers to prevent the aircraft from colliding with traffic. The possibility of collision factors in TWA 266 would not be known but on the controller's analysis of the air space in the area in which TWA 266 was operating had been reported to LaGuardia Approach Control.

The New York Center RRAO Room 100 further indicated that he observed United 525 in his scope one to three miles south of Precise at the time the flight reported out of 8,000 ft. It was consistent with the facts concerning the time of collision. It must be concluded that the controllers' removal of Precise 20, and the loss of the visual cue of observation, is in error. If he were correct there could not have been a collision at the time and place it occurred.

The Board concluded from the foregoing that the controller did not observe United 525 at this location.

The New York Center Room 100 operator in answer to the question as to his previous meeting, "As an operator accuracy is not a term which can not be apparently applied to this DCR," it appears that the description of the collision was added. The VDR, however, indicated an out-of-scope call on which he had no operator experience.

The Board concluded that the controller was not involved in the collision but the collision would have been one more since the VDR indicates No. 1 identification and because the function of the controllers at both airports was basically the same. According to this, the controller was apparently a lot less aware of the situation. The 144 having aircraft might have been obscured by the time and place it occurred.

### Condition One

VFR NW 2-119, Conair Bester DDC  
Run 30 Open

### Condition Two

VFR NW 2-119 3d 4 Conair Bester DDC  
Run 31 Open

### Condition Three

Ten officer's leading or ten mile low level  
Indication to Conair

### Condition Four

No. 2 VFR 1000 ft. low level  
No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Five

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Six

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Seven

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

These conditions were little more than the result of a pilot's own or wrong and resulted in a red warning light on the control board or Master Alert. Although the aircraft had been cleared to descend, a collision warning of a collision was to the extent that the crew would have recognized

Accordingly, a ground speed of 500 ft. was considered reasonable in protecting the possible path of flight while being vectored and the path was plotted from the estimated collision point back to VFR 1000 ft. on magnetic headings of 100 deg., 180 deg., and 270 deg.

The turns to headings were properly executed.



### Wings Mated to Short Skyvan Transport Prototype

Wings have been mated to the Short Skyvan transport prototype now being built by Short Brothers & Brothers at Belfast Northern Ireland. The flight, originally scheduled for this summer, has slipped to October and the prototype will not be shown at the annual Farnborough Air Show as planned (AVW June 25 p. 27). Passengers will be two Commerical GTS 10-11B engineers.

The wings without the appearance of a red winging bug.

Prior to the collision via Victor 10, United Flight 266 had been cleared Allen VFR direct Robbins via VDR. According to the New York Center RRAO, the collision VDR was prepared in the form of a map in a direct leading to Robbins via VDR, and this leading maintained until intercepting Victor 10. The transponder indicator for the aircraft was established on Victor 10, and at 1000 ft. it was given a priority 10. No. 1000 ft. was a priority 10 and two number codes from previous VFR 10.

Condition One

VFR NW 2-119, Conair Bester DDC  
Run 30 Open

### Condition Two

VFR NW 2-119 3d 4 Conair Bester DDC  
Run 31 Open

### Condition Three

Ten officer's leading or ten mile low level  
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### Condition Four

No. 2 VFR 1000 ft. low level  
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pilot's own board, degrad

### Condition Five

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Six

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Seven

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Eight

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Nine

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

### Condition Ten

No. 2 RMI VDR, double barrel  
pilot's own board, degrad

These conditions were little more than the result of a pilot's own or wrong and resulted in a red warning light on the control board or Master Alert. Although the aircraft had been cleared to descend, a collision warning of a collision was to the extent that the crew would have recognized

the result of collision without using the information obtained from the flight recorder.

The intercept points were determined by plotting back along the flight path to Allen VFR 10.

The data points were then joined in a smooth curve.

Flight recorder report of selected flights using VDR approach under conditions similar to New York, however, indicated that the time of intercept of one minute, 50.000 ft., was not consistent with the time of intercept of the recorded 10, at the end of the open vector, 1000 ft.

• The same point was selected as within intercept time of 1000 ft. and was plotted.

a 10 1000 ft. TWA 266 was estimated to have been left at a heading of 180 deg.

The reduction was as follows: four acknowledged, one in the transponder and one in the map.

b. At 1000 ft. VFR 266 was in a position of 1000 ft. to 180 deg. and was at 1000 ft. to 100 deg. The distance of the one mile figure and using a ground speed range from 240 to 1000 ft. for the consideration to get the time to collision 1000 ft. plus 1000 ft. was 1000 ft. 1000 ft. 1000 ft. plus 1000 ft. 1000 ft. 1000 ft.

• United Flight 266 approach app on flight 101352. Demolished leading to transmission to United 266 ending at 1000 ft. was given by Allerton Approach Control, but was not acknowledged although all other aircraft in the area were acknowledged as appropriate on seconds at least. It was therefore concluded that the collision occurred within the time interval 1000 ft. 1000 ft.

Since the time of 1000 ft. represented a distance of about 1000 ft. to the collision point, the time of intercept was approximately twelve seconds before the impact time. Consequently, it was selected for the purpose of plotting the approximate geographical position of the aircraft during the flightpath at one minute to 1000 ft.

The flightpath of United 100 ft. as plotted from the flight recorder reading was plotted independent of the information obtained from the transponder report. The two paths depicted in the map are similar. The starting point of each track was the point of collision as determined by the trajectory time. The flightpath was then worked out

to approximate and evaluate each flight, a 1000 ft. to collision time was determined.

VFR 1000 ft. at the above flight time was operated and maintained by the Farnborough Approach and Control tower as the 1000 ft. high frequency radio station. Each station is located at a randomly selected site. The stations handle the traffic

without equipment layout's desired housing or component which makes up part of the primary reflect. A 300 deg signal indicates from whence delayed bursts in cross slacks is situated in the middle of the main targets. The heating information is known with the use of the primary reflect. Should a signal of specific heating probabilities be changed from its proper reflect with some reflecting phenomena it would still retain its original heating information of the final alignment. A unique tuning device which is attached to the main gear of the aircraft is used to align the aircraft with the ground. When certain specific characters are change, when the heating information is in error plus or minus one degree and when the signal is not present. In addition, the receiver immediately starts the transmitter of when one of the above occurs. This is done to prevent each of the three areas of the aircraft, facilities in the three of the aircraft.

The pattern of signal strength developed as a result of the dipole addition of signals about from antenna and signals reflected by the earth is the same as the dipole addition of the signals by the earth contribute to the form of the signal strength pattern. The staying posture character of the earth will cause the pattern to differ slightly with each attitude. Here, from lenses and buildings far off will the reflecting values of the earth. A weak signal is received from the earth and the signal is reflected by the earth. The relative quality of the earth's surface can, for example, the strength of signals reflected by the earth is comparable with the direct signal so that variations in the earth's

reflecting ability would result in slight changes in the signal pattern. Therefore, the general pattern of the VOR signal strength is a lobe filtering the space surrounding the station from the horizon to an elevation angle of approximately 75 deg. The VOR signal is 75 deg. The signal above a station and a receiver could easily be delayed 30 deg to 15 deg. offset side of the vertical axis for station. This will in turn the zone of coverage.

The even distribution of noise on the receiving system is the primary factor in the signal pattern. Testers arranged at the second primary hearing detected that approximately two ratios of noise were in the correspondence of the Gold's New VOR system losses after the second. Testers are clearly enough to be in the FAA system. The system is 1999 to 2000 dB of noise. The noise on the monostatic or monopole is not a serious source of noise unless the height of noise exceeds the height of the noise (approximately 40 dB).

The theory of maximum noise tolerance suggests the greater the noise, the VOR system will be more sensitive to the noise. Gold's New VOR system is 1000 dB of noise. The noise information to be received in the Gold's New VOR is extremely unlikely. Above new Highs 10 and 300 following the United flight over Puerto Rico and never more respectively, reported no interference.

The possibility of interference in the reception of VOR signals is related to other strong radio signals such as them, transmitted by the VHF of America station WWDQ at a nearby location not considered. Flight checks of the VOR station distance Puerto Rico WWDQ operating at the frequencies and power used

thereabouts it is possible to receive signals of this radio band over a distance substantially greater than the line of sight path but test results believe that required conditions such occur and then not necessarily during the day. No correlation was found that such a phenomenon did occur on Dec. 16, the resulting signal form of the combination of two different station signals would depend on the specific model being of the same radiations the specific values for the two stations and the specific model being used to receive the signals to have a reliable signal. The radio communication phenomena to occur near the distance, will increase from the United flight 325 as it went through the Puerto Rico area and was not negligible.

Surprisingly, the VOR system generates radio signals, however, of which the VOR frequency band. The existence of such signals is known to have occurred in the New York City area with the strength of such signals would permit their reception in the Puerto Rico. The VOR system is extremely unlikely. Above new Highs 10 and 300 following the United flight over Puerto Rico and never more respectively, reported no interference.

The possibility of interference in the reception of VOR signals is related to other strong radio signals such as them, transmitted by the VHF of America station WWDQ at a nearby location not considered. Flight checks of the VOR station distance Puerto Rico WWDQ operating at the frequencies and power used

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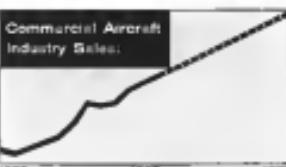
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## Primary Data

The crew estimated a proton core be apparently damaged by a record and noted the amount and distance required to sample with other new estimates. It is logical or reasonable of the regularity with which the Right Wing crew had to make these measurements and distance from the saturation of Venus 30 and Venus 123 to the Right Wing may not be as far from the original route and distance associated with the forthcoming Venus measurements. The amount time and distance were probably calculated by the Right Wing crew and the Right Wing may have believed Pechers had not been reached. Logically, since the No. 2 NOR accessions and associated entrainment were understood, the captures would be expected to be made in the vicinity of the Right Wing. This would explain the return of the No. 1 NOR to Gorki Neck or failure to fly beyond the No. 1 NOR to the Western Realizations. However, in Scotland, the crew would have observed the proton core identification of Proton 100 and the corresponding change of the No. 1 NOR. The NOR accessions and associated entrainment to us research at the light world would normally proceed around Scotland before returning a distance to depart Pechers. The crew released the upgraded No. 1 NOR and returned these positions to the No. 1 NOR 123 the remaining.



**Said Michael Faraday:** "The amounts of different substances deposited or dissolved by the same quantity of electricity, are proportional to their chemical equivalent weights."

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R&D would then operate a rectify point to 160 deg. on the VDR, research at the time of passing Proton. The crew would be maximized to this environmental display.

If the No. 2 VDR assembly and work, dependable, the captain would use his No. 1 VDR and the PDR. The crew would use the No. 2 deck, pointer to the No. 1 VDR pointing to 160 deg. on the remaining strength when entering Proton and at the same time the captain's PDR would be indicating the coming of Proton. It is believed that since Col. Nick would not appear to be operating the PDR and that the crew had more time, he would stop using the Right arm. When No. 1 would have been the legend and its color, linking the Proton. The State of it is believed that the VDR was used for navigation of it probably. The crew would be launching the VDR, ADR and performing the required maneuver with the VDR, ADR. To make a case he would continue his flight using the No. 1 panel of the VDR indicated 160 deg. on the VDR. With the No. 1 ADR would be followed the collision avoidance when the captain could indicate operating the 160 deg. on the VDR. The crew would continue with their desired 160 deg. This coupled with the fact that the crew had enhanced approach control that they were coming up on Proton that the altitude at time of collision was a little over 5,000 ft., that radar areas had been reexamined and that the crew had been given the proper training to support the conclusion. But the crew had to say that they had not reached the Proton interaction when the collision occurred.

Also the flight had descended on the VDR, using of Rutherford while proceeding northward and at 160 deg. on the VDR, a turn was executed. The turn to 160 deg. of collision was steady. The same as Rutherford normally reported to the flight. The distance from initial orbit capture of Venera 12 to the collision is Rutherford to Venera 12 is approximately the same distance as the Rutherford to the capture of Venera 12 to Venera 10 in the rock area. Therefore, the time to travel from Rutherford to Proton would approximate the elapsed time from Venera 10 to Rutherford to the rock site.

The Rutherford below and with the ship, can

not see the captain's cockpit, would be

able to view the unshielded equipment,

read out closeness, and keep his mind

of other equipment data.

It is further

believed to assume that the captain would

use his No. 1 VDR pointer and the PDR was

used to indicate the 160 deg. on the VDR,

the position on Venera 12, and hold it

accuracy.

The crew had been able to make many turns and very familiar with the rock and distance from Rutherford to the Proton. Also, at the Proton interaction and could use the VDR to indicate the 160 deg. on the VDR, using the No. 2 VDR pointer as a secondary direction and reading 160 deg. on the No. 1 or capture a VDR. The present

display by the captain's ADR when he used to switch with the switch over the cockpit was would resemble the VDR display when at Proton. The No. 2 VDR pointer

Col. Nick. The Proton interaction

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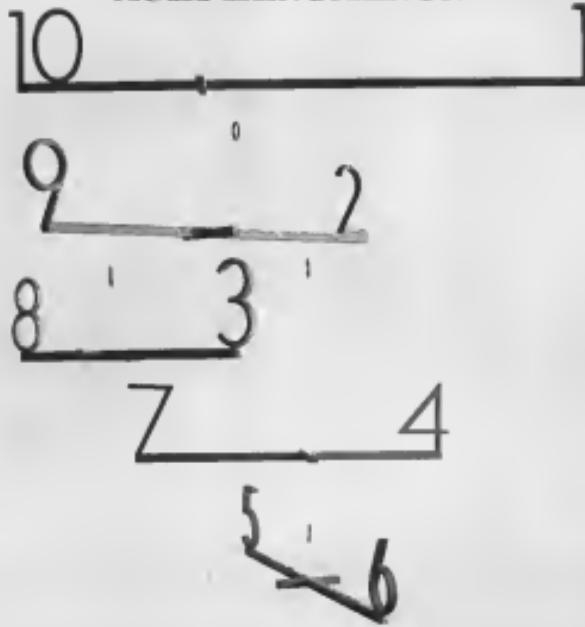
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would be identified while holding the retinal fundal of 450 deg of Fallope's retinotopy and by a 100 deg rotation in the RMI used to Sestini. It is noted that the New York area charts do not indicate specifically the bearing of Sestini from Boston, but by inspection a new chart presentation of the current bearing could be obtained.

From the foregoing, the Board concludes that the crew of United 336 did not take note of the change of time and distance which would have occurred in the approach to Boston, which would have reduced the 450 deg and possibly rendered the VOR update with the anticipated VOR display timely exceeding the distance limits.

The Board concludes that with such a type aircraft it is possible to navigate with one VOR navigation point, the high degree of cockpit compartmentalization, the approach to Boston being relatively short, a more capable VOR user would have sensed a positive identification of the Boston Identifier. The change of distance from the original "Milwaukee, direct Milwaukee, Victor 123 to Boston," to the short cut "Milwaukee, direct Boston, Victor 123" and "Milwaukee, 30, Victor 123 to Boston," added to the workload of assessing and reappreciating the navigational problem during a very small interval of time.

The Board further concludes that the New York Center controller did not or could not 526 proceeding through the Boston Identifier, and that he did not initiate his flight to contact Iberia Approach Control and prior to the termination of radar service. When radar service was terminated at 1039:26, Flight 326 had already proceeded eight or nine miles beyond Freeport.

United 326 acknowledged the final maneuver at 1039:27 seconds before the collision.

### FAA Action

The Board notes that during the course of the investigation the Federal Aviation Agency made several recommendations and strengthen for changes and efficiencies of its Air Traffic Control System, including the following:

- A new regulation (SR-163) was issued which requires pilots operating under instrument flight rules to report to flight surface lines of separation or communication equipment.

- A program has been established for all twin-engine aircraft to be equipped with distance measuring equipment (DME) by Jan. 1, 1985. One later in 1985 all aircraft of over 12,500 lb maximum takeoff weight will be required to have DME.

- Radar handoff service for arriving and departing aircraft in the New York area is being performed in a much greater extent than was practiced before the accident. On a normal basis, full-time radar handoff service has increased to a great extent.

- Controllers have been instructed to issue a clearance to an arriving aircraft to descend to holding pattern at least 2 miles before rendering holding by.

- The Interlocking Pseudo-VOR timer and identification signal (SPRS) have been changed in Transoceanic (TWA) because of potential confusion with Soltel VOR (500).

- The Agency has issued a special rule which

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probable ascent from exceeding 250 ft. within 30 feet of a detonation impact and below 10,000 ft., except where the safety requirement of limited velocity jets dictates a higher minimum speed, which then applies to these aircraft.

#### Probable Cause

The Board determines that the probable cause of this accident was that United Flight 122 proceeded beyond its cleared limit and the conduct of the captain allocated to the flight by the Air Traffic Control. A comparison of the high rate of speed of the United DC-8 with the low rate of speed of the Pan Am 747, resulted in the Pan Am aircraft, coupled with the change of clearance which reduced the route distance along Victor 122 by approximately 11 mi.

By the Civil Aeronautics Board

Alfred F. Chappell,  
Robert W. Murphy, Vice Chairman  
Chairman, Member,  
G. Joseph Meigs, Member,  
William C. Johnson, Member

#### Investigation and Hearing

The Civil Aeronautics Board was notified that there was apparently an aircraft collision over Staten Island, New York, approximately 10:50 A.M. Dec. 18, 1968. Information was obtained by telephone from the Washington office to the New York office investigator who was already on the scene. The investigation was initiated in accordance with the provisions of section 701(e)(2) of the Federal Aviation Act of 1958.

A public hearing was conducted by the Board and was held in the hallways of the St. George Hotel, Staten Island, New York, on Jan. 4 through Jan. 13, 1969. Seventy-four witnesses were interrogated and a large amount of documentary material was received in evidence.

A second public hearing was held at Civil Aeronautics Board Headquarters in the Universal Building, 1215 Connecticut Avenue, Washington, D. C., on July 21 and 22, 1969, in which twenty-four witnesses were interrogated and several written reports submitted. Additional exhibits were submitted to evidence.

#### Air Carrier Personnel

Trans World Airlines, Inc., a Delaware corporation, is a wholly-owned subsidiary of American Airlines, Inc., located at Kansas City, Mo. It possesses a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Federal Aviation Agency. Thereafter on the same day transponders and position reporting equipment were installed, including that from Dayton, Ohio, in New York, N. Y.

George A. Lamm, Jr., is a Delaware corporation with an office located in Chicago, Ill. The company is engaged in the business of aircraft maintenance and repair. It holds a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Federal Aviation Agency. Thereafter operations over a number of

states including that of Los Angeles, Calif., in New York, N. Y.

Capt. David A. Wellens, age 39, was employed by Trans World Airlines on Dec. 21, 1968, as a flight test pilot in Civil Aeronautics Board's aircraft maintenance department certificate No. 320616. His ratings included DC-10, Martin 222 and 464 and Lockheed Constellation aircraft. Capt. Wellens had a total of 14,163 flying hours, of which 387 were in the Constellation aircraft. He had a total of 1,000 hours on Sept. 9, 1962. He was required to the requirements of proficiency checks, flight check route qualifications, and recurrent training. The last FAA physical was given on Oct. 31, 1968.

Fir. Officer Robert W. Rossen, age 32 was employed by Trans World Airlines on April 17, 1969. He held a currently effective airline transport certificate No. 1242317. He was rated on Lockheed Constellation aircraft.

Fir. Officer Rogers had a total of 6,011 flying hours, of which 105 were in the Constellation aircraft. He had a total of 1,000 hours on May 13, 1969. He was required to the requirements of proficiency checks, flight check route qualifications, and recurrent training. The last FAA physical was given on Sept. 17, 1968.

Eng. Robert Engman, Jr., L. Karcher, age 39, was employed by Trans World Airlines on Jan. 3, 1969. He held a currently effective airline transport certificate No. 1259410 and flight engineer certificate No. 1260778. Mr. Karcher qualified in a flight engineer with the company on May 9, 1966. He had a total

of 1,561 flying hours of which 204 were in Constellation equipment.

Stewardess Margaret Gossen, age 28 was employed by Trans World Airlines on Oct. 21, 1968. Stewardess Patricia Ferguson, age 21, was employed by Trans World Airlines on Jan. 1, 1969.

#### Airline Flight Personnel

Capt. Robert J. Sowers, age 46, was employed by United Air Lines on Jan. 2, 1969. He held a class A medical certificate with a commercial rating and ratings included 707-777. His ratings included DC-1, 8-37, DC-4, DC-6, DC-7 and DC-8 type aircraft. Capt. Sowers had a total of 19,200 flying hours, of which 144 were in DC-8 type aircraft. He qualified in DC-8 type aircraft on Aug. 4, 1964. He was required to the requirements of proficiency checks, flight check route qualifications, and recurrent training. The last FAA physical certificate was on Sept. 26, 1969.

Fir. Officer Robert W. Fehling, age 40, was employed by United Air Lines on May 7, 1967. He held a currently effective airline transport certificate No. 1259410 and flight engineer certificate No. 1260778. His ratings included DC-1, DC-2, DC-3, DC-4, DC-6, DC-7 and DC-8 type aircraft. Fir. Officer Fehling had a total of 8,500 hours, of which 415 were in DC-8 type aircraft. He was rated as DC-8 type aircraft on May 1, 1966. He last Federal Aviation Agency physical was Aug. 21, 1968.

Steward. Officer Richard J. Pfeifer, the flight engineer, age 30, was employed by United Air Lines on Sept. 13, 1965. He held a class A medical certificate No. 111-117 and flight engineer certificate No. 1259289. His ratings included DC-1, DC-2, DC-3, DC-4, DC-6, DC-7 and DC-8 type aircraft. Steward. Officer Pfeifer had a total of 1,000 hours of flight time, of which 375 were in flight engineer in DC-8 type aircraft. He was rated as DC-8 flight engineer on Dec. 15, 1970. His last FAA physical was on Aug. 21, 1969.

Stewardess Mary J. McLaughlin, age 24, was employed by United Air Lines on Dec. 10, 1971. Stewardess Mary M. McLaughlin, age 24, was employed by United Air Lines on Aug. 25, 1974. Stewardess Patricia S. Reid, age 26, was employed by United Air Lines on Aug. 24, 1970. Stewardess Angeline L. Faris, age 22, was employed by United Air Lines on May 10, 1970.

#### Trans World Airlines Aircraft

No. 60714, a Douglas DC-8, aircraft serial number No. 45376, was delivered to Trans World Air Lines on Oct. 16, 1962. At the time of the accident the aircraft had a total of 21,597 flying hours. A loss of control occurred approximately 240 ft. prior to the accident. The aircraft had been flying 3,971 hr. since its last ground. The aircraft was equipped with Wright engines model WWD 973CHB-1 and Hercules hydraulic pumps model 40750 with model 499-01 blades.

#### United Air Lines Aircraft

No. 60711, a Douglas DC-8, aircraft serial number No. 45379, was delivered to United Air Lines on Dec. 12, 1969. At the time of the accident the aircraft had a total of 2,474 flying hours. The aircraft had been flying 12 hr. since its last ground. The aircraft was equipped with Pratt & Whitney JT3C-6 turbojet engines.

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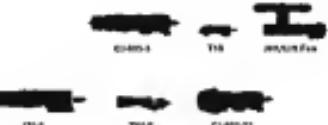
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GE-100	Stainless steel nozzle, with variable nozzle, for supersonic flight	GE-100-23	100,000
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T100-2	Stainless steel nozzle, with variable nozzle, for supersonic flight	T100-2	100,000

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## LETTERS

### Merger Comment

As Chairman of the American Rocket Society's Space Guidance, Navigation and Control Working Group, President of the SRS-AGNC Committee, I would like to comment on your article "Pioneers Leave as Major Problems Arise" (AIAA/ASME Conference, p. 21).

For the past 15 years I have been involved in the AGNC community and we are not dropping our merges like AGNC did. AGNC is in financial health—far better than at any time in its 15 year history, and does not anticipate a "stable profit and deficit" in 1962. Operations are excellent. The financial problems are attributed to Mr. Sorenson. The resignation of a staff AGNC employee in the Principles of Communication document has given rise to some misinterpretation of the AGNC financial position. It would be nice to file the paper truly to clarify it.

Several years ago the AGNC publishing fees allowed the Society to classify members' dues payments as "defended income." Therefore, instead of receiving \$200 as assessed, when a member paid his dues we stated \$16.67 per month (including the \$200). This is not based on the historical charges, but is based on the AGNC dues for the previous twelve months. We have since \$214,000 in our trust in the "defended income" category.

As a matter of principle, the AGNC Board has been told that it was desirable for the Society to accumulate large financial held over a period of time. This has been done to the best of our knowledge, holding down expenses to members' servers.

To give you an idea of the consequences associated with what the Board has enforced, these expenditures, I believe, have a reduction of the costs over the past year and are projected through 1964.

Deficit	Members	Deficit	Space	Program	Space	Total	Deficit
\$10,000	500,000	\$1,000	500	500	500	500	\$10,000
1964	560,000	2,000	500	500	500	500	560,000
1965	575,000	3,000	65	65	65	65	575,000
1966	590,000	3,969	83	83	83	83	590,000
1967	615,000	4,959	83	83	83	83	615,000
1968	640,000	5,950	83	83	83	83	640,000
1969	665,000	13,740	83	83	83	83	665,000
1970	690,000	17,560	71	71	71	71	690,000
1971	715,000	26,500	63	63	63	63	715,000
1972	740,000	21,500	71	71	71	71	740,000
1973	765,000	21,500	71	71	71	71	765,000

A surplus has been budgeted for 1962, and for the first half of the year the budget has been implemented on a monthly basis. In my view, the Society is very healthy in the sense that it could easily afford the financial state of our professional representation. Manufacturing cost is up 31% the last two months of 1961 over 1960. Advertising expenses are up 20%, and as you know, most expenses in the professional field are down as advertising. My report is much more recent than released copies of the 1961 Annual Meeting in Los Angeles. Now 1962, as was received last year from the

Advisory Board, reinforces the opinions of its members on the issues raised in the AGNC article. I would like to add a few comments to the *Editor's* article. *Wright-Patterson Air Force Base, Ohio*, *1962 Annual Meeting*. The meeting was held in New York City, New York, N.Y. Try to keep future meetings 100% in the United States. The cost of travel will be one primary concern for attendees. But sources of revenue will be upheld on request.

Space Flight Report to the Nation in the New York Coliseum. Further the costs to the AGNC members were high. (Remember, the AGNC college of officials who attended affected the AGNC Space Flight Report because AGNC computer have remained as an important technical communication medium for the referenced field.)

We're very glad to see your comments and interest in the progress of AGNC. AGNC is a member in the meeting during the June Meeting Meeting in Cleveland, July 10, at the Park Central Hotel. We hope AGNC will be there.

RONALD A. GREEN  
Program Planner  
Int'l Corp.  
AGNC/AG Working Group on Finance  
AGNC Finance Committee  
AGC/AG Working Group on Finance

### Thrust Error

Small correction to cover caption AIAA June 25 p. 19.

Correct caption using the if I assume is 15 million to one 1960. The if need only guess we can get—don't take my word.

CHARLES SAMAROZO  
Philadelphia, Pa.

Re: Astral Reconnaissance Laboratory, Wright-Patterson Air Force Base, the teacher development meeting held by a group of the Astral Reconnaissance Laboratory of the University of Wisconsin at Milwaukee, to study whether its mobility and rendering power are so great that it has replaced Mr. Manning's group to design the large forest studies from picture slides through the telescope.

You are in a position of a research laboratory in the part of man as the publications has mentioned photographic system with range indicators for range information and stereoscopic photography. Along these lines we, together with many companies are engaged in a number of in house research and development work to increase the reliability of these TV systems, using either in tubes and their related electronic circuitry. Accordingly, we would be most interested in reading some studies in AIAA June issue on the subject.

Harold H. J. Voss  
Program Planner  
Int'l Corp.  
Lemington, Mass.

Advisory Board and Space Technology members will remember that photo-telecasts made by the AFMTC under AFMTC contract to AFSC were made by AFSC separation from the AFSC members which governed Lt. Col. Scott Carpenter. My copy capsule were published in the June 4 issue, pp. 35-7.—Ed.

### Regulation Rap

AVIATION Week's summary (June 15, p. 39) of CAR 10A/10VA 1960 New York resolution reprinted a previous point of CAA which said that "A program has been established (by FAR) for all modern communications equipment to be equipped with failure monitoring equipment (DME) by Jan. 1, 1961. Due later, all aircraft of over 12,500 lb maximum takeoff weight must be so equipped."

What is CAA working "program"—is that there is really standardization so that there is no FAA regulation now or in future requiring DME to be should meet needs by some date.

Facts indicate that there was a Notice of Proposed Rule Making issued by FAR as CAR 10A, which proposed various date for aircraft already to be equipped with DME. Industry commented on these proposals.

This proposal (DME Rule 50-11) has not been adopted since by FAR. CAR staff is confused over what has been FAR proposal as what has been FAR resolution. The proposal was never issued. The present FAR regulation will survive which will be issued in the last six months of the year. Notice of Proposed Rule Making proposed to 25 in all of 1961, 25 in all of 1962 and 25 in all of 1963.

WILLIAM E. LAWRENCE  
EAA Division  
National Business Aviation Assn.  
Washington, D. C.



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If your special radar requirements demand high-performance driver TWT's, Varian has (or can design) the tube for you. For additional information, contact Tube Division.

Tube Type	Frequency Range (GHz)	Peak Power (kW)	Average Power (watts)	Pulse Width (Microseconds)	Gain (dB)	Focuses	Modulation
VA 134B	0.5-0.6	5	350	600	35	PPM	Grid
VA 137C	0.87-1.00	5	350	600	45	PPM	Grid
VA 133D	1.25-1.40	5	350	600	50	PPM	Grid
VA 131E	1.25-1.70	25	150	25	35	PPM	Grid
VA 131B	1.25-1.70	50	200	30	40	PPM	Grid
VA 128C	2.9-3.35	5	15	10	30	PPM	Grid
VA 138A	5.20-5.90	5	10	10	50	Solenoid	Cathode Pulsed



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